ARMY ORDNANCE

VOL. XIII, No. 78 MAY-JUNE, 1933

The Arms Embargo Resolution

John Bassett Moore

Modern Naval Armament

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Early History of American Ordnance

Brigadier General William H. Tschappat

Consider the Manufacturer

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General Hagood's Reorganization

An Editorial

A BIMONTHLY REVIEW OF AMERICAN MUNITIONS
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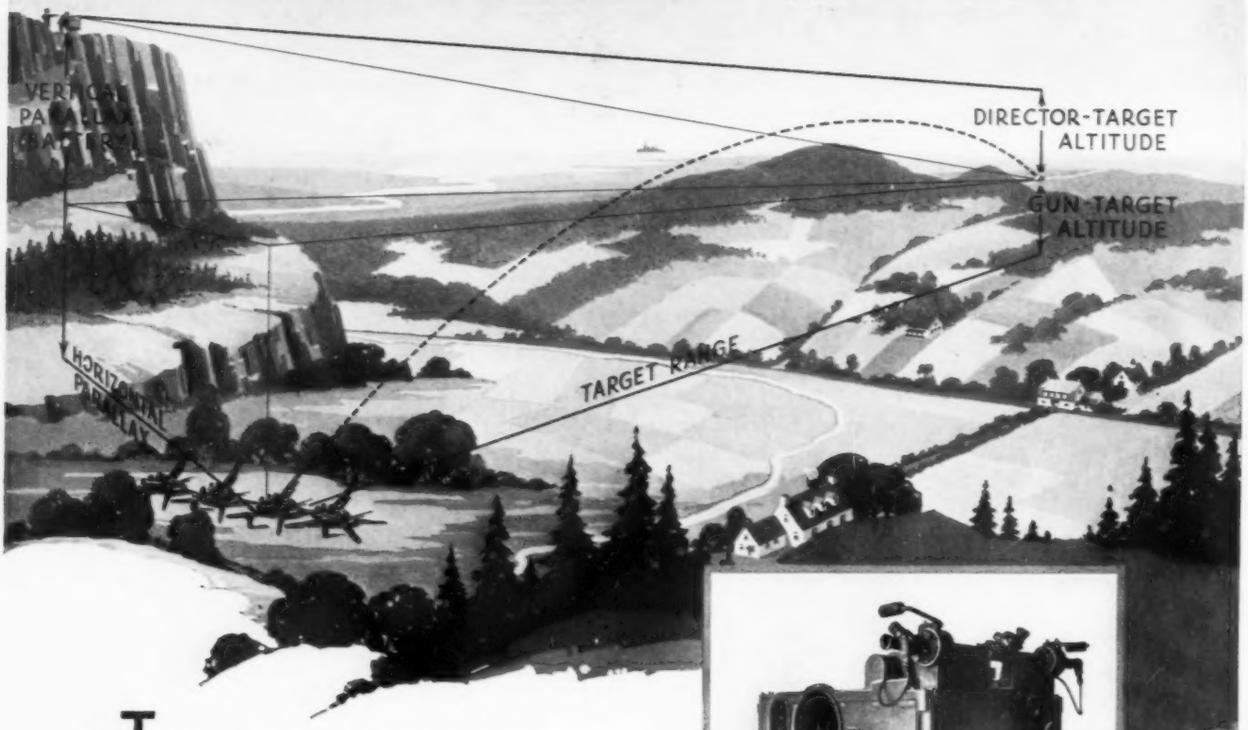
MODERN FIRE CONTROL



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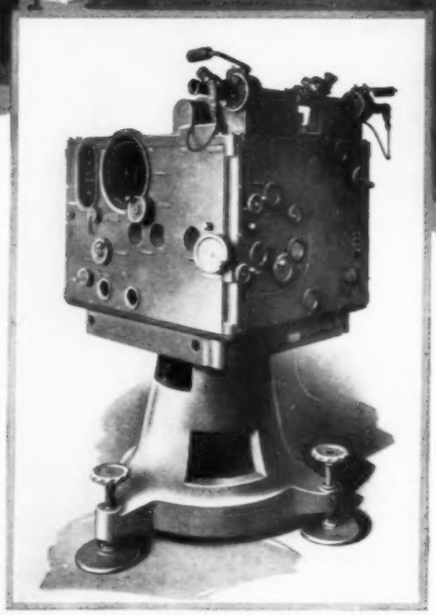

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Founded 1920

Fledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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"The safety and interest of our people require that they should promote such manufactories as tend to render them independent of others for essential, particularly military, supplies."—*General George Washington in his First Annual Address as President of the United States, January 8, 1790.*

The Army Ordnance Association

THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guarantee of peace.

The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

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The Association is purely patriotic; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American scientists, inventors, engineers and manufacturers in civil life and the regular and reserve officers of the Ordnance Department.

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the industry of the nation and by the officers and civilian employees of the Ordnance Department in the wars in which the United States has been engaged.

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ARMY ORDNANCE

Vol. XIII MAY-JUNE, 1933 No. 78

The Arms Embargo Resolution

Objections from the Standpoint of International Law

By John Bassett Moore*

IT WILL soon be twenty years since the outbreak in Europe of what eventually became known as the "World War." Following that unfortunate event there developed, in the ordinary course of things, a war madness, manifested in the exaltation of force and the belittling of the enduring legal and moral obligations which lie at the foundation of civilized life. Peaceful processes fell into disrepute. We began to hear of the "war to end war;" and pacifists, enamored of this shibboleth, espoused the shallow creed that international peace could best be assured by the use of force or threats of force. We were told that preëxisting international law had suddenly become obsolete and that the world had entered upon a new era in which the general tranquility was to be maintained by "sanctions," by boycotts, and by war. But the final stage was reached in the spawning of the notion, now rampant, that peoples may with force and arms exterminate one another without breach of the peace so long as they do not call it war. This may appropriately be called the stage of bedlam. In all this, however, students of history will find nothing new. The development of such manias normally characterizes the progress of a great war, just as their decline marks the return to sanity.

To the final stage to which I have referred belong the supposition that the law of neutrality no longer exists, and that in future there will be no more neutrals. It is on this theory that the proposed arms embargo resolution is essentially based. It is true that the resolution does not in terms say so; and it is equally true that less is just now said about this phase of the subject than was said not long ago. But it is only on this theory that the sweeping terms of the resolution can be defended.

AS a lifelong student and administrator of international law, I do not hesitate to declare the supposition that neutrality is a thing of the past to be unsound in theory and false in fact. There is not in the world today a single government that is acting upon such a supposition. Governments are acting upon the contrary supposition, and in so doing are merely recognizing the actual fact. In the winter of 1922-23 there was held at The Hague an international conference to make rules for the regulation of the activities of aircraft and radio in time of war. The parties to this conference were the United States, France, Great Britain, Italy, Japan, and the Netherlands.

I had the honor to represent the United States in the conference and to be chosen to preside over it. We were able in the end to reach a unanimous agreement, which was incorporated in a general report. An examination of this report will show that it was largely devoted to the definition of the rights and duties of belligerents and of neutrals in time of war, and that it treated as still existing the Land War Neutrality Convention, the Convention for the Adaptation of the Geneva Convention to Maritime Warfare, and the convention concerning Neutral Rights and Duties in Maritime Warfare, all made at The Hague in 1907. The conference by which the report was adopted took place more than two years after the making of the Versailles Treaty and the Covenant of the League of Nations; the various delegations, it should be needless to state, acted under the authority and instructions of their respective governments; and yet, the idea that the law of neutrality had become obsolete never was suggested. So far as I am aware, not a single party to the Versailles Treaty or a single member of the League of Nations has ever actually taken the position that the law of neutrality is a thing of the past. The principal powers in the League have on occasion taken precisely the opposite position.

The fact is notorious that, after the Greeks were egged on to make war on the Turks and war actually came, Great Britain decided to remain neutral in the conflict, into which Canada and perhaps some of the other self-governing Dominions unequivocally announced that they would not be drawn without their consent. In other recent wars Great Britain has pursued a neutral course. Other governments have done the same thing. No government, so far as I am advised, has repealed its neutrality laws. Those of the United States still remain on the statute books; and, if they are to be repealed, it should be done directly and not by implication or by embarking on a lawless course in the name of peace.

WE hear much today of the duties of the United States as a "world power," and the supposition seems widely to prevail that we have only lately reached that eminence. I am too good an American to think so poorly of my country and its achievements. The United States has always been a world power. It acted as a world power when, on the outbreak of the wars growing out of the French Revolution, its first President, George Washington, with Thomas Jefferson as his Secretary of State, proclaimed our neutrality. It acted as a world power when, some years later, it suppressed the activities of the Barbary pirates.

It acted as a world power when, in 1812, it went to war in defense of neutral rights. It acted as a world power when it proclaimed the Monroe Doctrine. It acted as a world power in extending its trade and opening up foreign countries to its commerce, as it so effectually did by peaceful processes during the Presidency of Gen. Andrew Jackson. It acted as a world power when it refused to permit the intervention of foreign

*Member of the Permanent Court of Arbitration, The Hague; formerly assistant secretary (1898), and counselor (1913-1914) United States Department of State, and, until 1928 a Judge of the Permanent Court of International Justice. This article was submitted as a letter to the Chairman, Committee on Foreign Affairs of the United States House of Representatives.

nations in our Civil War. It acted as a world power when it forbade the further maintenance of the European empire set up in Mexico by French arms during our Civil War. It acted as a world power when, in the administration of President Grant, with Hamilton Fish as his Secretary of State, it brought about, through the greatest of all international arbitrations, the amicable settlement of the Alabama claims, and in so doing made a signal contribution to the further development of the law of neutrality. It is useless to continue the specification of instances. Nations, like individuals, may increase their power by combining with a due attention to their own business the extension of their friendly offices to brethren in trouble, and by conserving their militant resources for occasions when their vital interests are at stake. A nation that undertakes to meddle with every foreign disturbance is bound to become an international nuisance, to its own detriment as well as to the annoyance of other countries. Power is neither gained nor kept by such methods.

IT is obvious that certain recent agitations have been and still are carried on under radically erroneous impressions as to the legal significance of the supply of arms and munitions of war to the parties to armed conflicts. The statement is often made that the trade in contraband is lawful, and the statement is also often made that such trade is unlawful.

These statements may seem to be conflicting; but, when properly understood, they are both correct. Because there is much dispute as to what the term "contraband" includes, and because it has so far been deemed proper to limit the burdens to which a neutral power is subject, international law has not up to the present time required neutral governments to prevent their citizens from manufacturing, selling, and shipping contraband, including arms and munitions of war, in the regular course of commerce. Hence, in the sense that a neutral government is not obliged to suppress such trade, the trade is lawful. On the other hand, however, international law recognizes the right of a party to a war to prevent such articles from reaching its adversary, and, if it seizes them, to confiscate them. In other words, international law, treating the trade as being, in an international sense, intrinsically unneutral and unlawful, permits the parties to the struggle to inflict the penalty, and to this the trader's government cannot object. The trader conducts the business at his peril.

But, while a neutral government is not obliged to suppress the contraband trade of its citizens, it is forbidden itself to supply contraband to a belligerent, and particularly is forbidden itself either to sell or to give to him munitions of war. Neutrality, in the legal sense, embraces not only impartiality but also abstention from participation in the conflict (Moore, Digest of International Law, vol. 7, sec. 1288, p. 863). The prohibition of the neutral government itself to supply arms and munitions of war is based upon the unquestionable fact that the supply of such articles to a fighting force is a direct contribution to its military resources, and as such is a participation in the war; and, if a government does this, it virtually commits an act of war. If it does this in behalf of one of the parties, it abandons its neutrality and is guilty of armed intervention; and if it does it for both parties, although it may be said to be impartial, it does what neither of the parties themselves can do, namely, fights for each, against the other. It is not long since the United States became, through an inadvertent failure to observe these elementary principles, involved in an unfortunate incident affecting a great and friendly American country, the Republic of Brazil. Happily the intervention quickly ended, as the government in behalf of which it was committed abruptly disappeared, and in a few days we duly recognized its successor, as 15 other governments promptly did.

From the elementary principles of international law above set forth it necessarily follows that, if a government bans the shipment of arms and munitions of war to one of the parties to an armed conflict and permits it to the other, that government intervenes in the conflict in a military sense and makes itself a party to the war, whether declared or undeclared.

THE pending resolution is, I do not hesitate to affirm, opposed to the settled policy and the highest interests of the United States and also to the provisions of our Federal Constitution. If adopted, it would enable the President (1) to make international engagements of the most far-reaching kind at his will, without the advice and consent of the Senate, and (2) to carry us into war without the prerequisite constitutional declaration of war by Congress. Perhaps it may be answered that by the proposed resolution the Senate would voluntarily abdicate its constitutional powers regarding international engagements, and that the Congress would likewise abdicate its constitutional powers regarding the declaration of war. This argument might be accepted if the Senate and the Congress could constitutionally divest themselves of their constitutional powers and commit everything to the Executive. But, as they were unwilling to do this during the so-called "World War," when it was proposed to give the President complete dictatorial powers, I can only suppose that the present extraordinary agitation is due to the misleading and somewhat deafening clamor of those who, in the name of peace, would confer upon the President an unlimited right to engage in hostilities.

I refrain from saying an unlimited right to make war only out of deference to the profound and learned authorities who assure us that war can be abolished either by calling it peace or by refraining from calling it war. This is, I may remark, a favorite notion with those who demand that the Kellogg pact shall be equipped with "teeth" in order that it may masticate alleged "aggressors," and otherwise benignantly bite and gnaw its way to universal peace and concord. Unfortunately, there are many who appear to have been infected with these confused notions, which have been so industriously propagated in the United States. But, judged by the course of the principal members of the League of Nations during the past ten years, and by their attitude toward the hostilities lately in progress in the Far East and elsewhere, such notions appear never to have had any real charm for the responsible authorities of the countries which would have been required to make the chief sacrifices in blood, in treasure, and in tears. To say this is not to impeach their wisdom or their sincerity. It may merely indicate that, having had enough of war, they long for real peace and an opportunity to recuperate.

Should the proposed measure become a law, no gift of prophecy is required to foretell what will follow. Groups moved by interest or swayed, consciously or unconsciously, by propaganda will clamor at the White House and at the Department of State for the unneutral application of the ban in favor of those whom they like or approve and against those whom they dislike or disapprove. We are assured that we may trust our authorities to resist such importunities and to refrain from doing things that would involve the country in

trouble. In other words, we are told that our authorities may be relied upon to refuse to exercise the powers so sweepingly conferred upon them. This is indeed a singular argument. Couched in the language of irresponsibility, it is not only self-stultifying but also unjust. The burdens and cares resting, especially at the present juncture, upon those who administer our affairs are already grave and harrassing enough, without imposing upon them the pastime of playing with war. Within the terms of the pending resolution, our Government would be asked to set itself up in rash and arrogant judgment upon the acts of other nations and on the merits of their conflicts, with a view to give or to permit military aid to one as against another.

BEFORE committing ourselves to this presumptuous program spun of the wild and flimsy fantasy that when nations fall out and fight the question of the "aggressor," which still baffles students even of ancient wars lies upon the surface of things, and may be readily, safely, and justly determined by outsiders, of whose freedom from individual interest or bias there is no guarantee, we should reflect the fact that had such a notion heretofore prevailed we might and in all probability should ourselves have been the victim of it. As a marshaling of all the incidents would unduly prolong this letter, I will call attention to only two.

During our Civil War we were more than once menaced with the possibility of intervention, and, had it taken place, no one can say how fateful would have been the consequences. But, as an American, I share with my fellow countrymen, as members of a great and united people, the universal sense that it is well that we were not permanently divided.

On April 6, 1898, there assembled at the White House the diplomatic representatives of six great European powers, who made in behalf of their governments what was called "a pressing appeal to the feelings of humanity and moderation of the President and the American people in their existing differences with Spain." We need not question the motives of the governments by which this remonstrance against our armed intervention was made. The President of the United States did not question their motives in his answer; but, with the conscious dignity that became himself as well as his great office, he expressed the confident expectation that the remonstrating powers would equally appreciate the effort of the United States "to fulfill a duty to humanity by ending a situation the indefinite prolongation of which had become insufferable." Two weeks later the Congress of the United States adopted a resolution under which the Government intervened with arms. The governments that had remonstrated against this step evidently did not regard Spain as the aggressor in the unhappy controversy between that country and the United States. The implication was clearly and directly to the contrary; and, according to the theory on which the pending resolution rests, the remonstrants, when the United States forcibly intervened might appropriately have declared an embargo upon the shipment of arms and munitions to this country, while continuing to supply Spain with the implements of war.

All this might, on the new theory, have been done in the name of peace, and, if the United States had exhibited resentment, this might have been treated only as further proof of its malevolent and aggressive disposition. It is better to reflect on such things while the opportunity still exists. It would be inexcusably shortsighted to assume that what has happened before will never happen again. We might also remember that our war for independence was treated by the great majority of powers merely as an act of rebellion against lawful authority. We waged the War of 1812 in support of disputed claims of national right. Many of our own people, including General Grant, have condemned our war with Mexico as an unjust aggression; but I am not aware that any of them has taken the ground that the general interest or the cause of peace would have been advanced if the powers of the world, some of which were not then themselves above suspicion, had combined their forces to oppose or to crush us.

If the real purpose back of the pending resolution is simply to prevent the United States from furnishing implements of war to those who are engaged in armed strife, this may readily be done by providing for a comprehensive, nonpartisan embargo on the shipment of arms to all countries engaged in armed strife, whether international or civil. Such an embargo would naturally be announced and imposed by public proclamation. Of this no foreign power could complain. There are already various countries which, in accordance with their laws, impose such a ban. This is entirely proper under international law. Whether such an inhibition would, without the coöperation of all other neutral nations, tend to limit the area, the destructiveness or the duration of wars is a conjectural matter on which I do not now undertake to pass. Nor do I intend to discuss the question how far such a policy may tend to render weaker nations, financially unable to maintain munitions factories of their own, incapable of asserting or of defending their rights against larger powers. Considerations such as these lie within the domain of policy. The general bans, where they exist, are based upon the belief that, as the supply of arms and munitions constitutes a military aid, it is better and safer to forbid it altogether. In imposing upon itself such a restriction a nation acts within its undoubted rights, and gives no just cause for reproach.

A Field Artillery Battery in Action.

Modern Naval Ordnance

Development of the Gun is Still of Vital Importance

By Hector C. Bywater*

ONE of the inevitable results of naval disarmament is the slowing down of progress in the development of naval weapons. Since the World War there have been no such revolutionary changes in this sphere as were recorded during the first fourteen years of the century. Within that comparatively short period naval guns of every caliber, as well as the methods of handling them, were improved almost out of recognition. In 1900 the standard heavy gun was the 12-inch 40-caliber, mounted for a maximum elevation of 15 to 16 degrees, and capable under service conditions, as distinct from well-rehearsed "show" performances, of discharging one aimed round every fifty seconds. In 1914 guns of 13.5, 14, and 15-inch were afloat, with lengths up to 45 calibers; a 14-inch 50-caliber piece was in production, and a 16-inch 45-caliber had been designed. Loading gear had been so improved that the heaviest guns could be fired at the rate of two rounds a minute. The angle of elevation had been raised to 20 degrees, and the introduction of scientific methods of fire control had virtually doubled the effective range of all guns. By November, 1918, an 18-inch gun, using a projectile of 3,200 pounds, was mounted in the British Navy, which also had a 20-inch piece in the blue-print stage. Whether these monster cannon were necessary or desirable is, for the moment, beside the point.

For three years after the armistice the great naval powers were too busy digesting the feast of technical data derived from the war to embark on drastic experiments in ordnance design. It is true that ships of phenomenal size were planned, e.g. the 48,000-ton British battle cruisers, to be followed by 50,000-ton battleships mounting 18-inch guns; the twelve United States capital ships, averaging 43,000 tons, with a 16-inch armament, and the Japanese vessels of approximately equal tonnage and power. But even in 1919 the Washington Conference was casting its shadows before, and on all sides there was a noticeable tendency to put the brake on naval construction. In what follows I shall touch as lightly as possible on the twin factors of economics and politics which largely, and most palpably, shape naval preparedness in all countries, and never more so than today; but to ignore them altogether is quite impracticable.

TO recapitulate the terms of the five-power Washington Treaty is not necessary. Suffice it to say that it established limits of 16 inches and 8 inches for the ordnance to be carried by capital ships and cruisers, respectively. Subsequent attempts have been made, chiefly by Great Britain, to reduce capital ship armament still further. At the Geneva Conference of 1927 the British proposed a limit of 13.5 inches. They have since advocated a maximum of 12 inches, and are even ready to accept 11-inch guns provided the armament of cruisers is restricted to 6.1 inches. So far these various proposals have not gained the universal support which is needed to ensure their adoption. They appear to be prompted by two motives: a desire to reduce the cost of future ships to a figure that would enable the present battle fleet to be replaced when the time comes without imposing too heavy a financial strain, and a genuine recoil from the fetish of materialism which has given us the monster ships and guns of today. Since the war there has been endless discussion in British naval circles on the subject of what constitutes the ideal ship of the line. When the argument began in 1919 a great gulf existed between orthodox, that is to say Admiralty, views and those held by the younger school of thought in the service. The Admiralty's ideal ship of that date was a super-Hood, with a battery of not less than 16-inch caliber, a speed of more than 30 knots, and heavy armor over all vital parts—desiderata involving a displacement of nearly 50,000 tons. The question of cost was hardly considered, for we in England were still thinking in terms of war finance, and a few millions more or less per ship didn't seem to matter.

But earnest students of naval history were convinced that the Admiralty was on the wrong tack. They were able to prove that the fate of naval wars, new no less than old, had been decided by the medium-sized ship; that in view of the relativity of strength no positive advantage was ever gained by increasing dimensions; and, finally, that the policy of piling up tons and guns was always defeated by the intrusion of the economic factor. To state the case more simply: two opposing fleets, each made up of 35,000-ton and 16-inch gun ships, represent exactly the same balance of power as they would if composed of vessels of half that tonnage and armament. Lord Fisher's Dreadnought policy ought to have exploded, once and for all, the fallacy that naval predominance can be achieved by building a super-ship. With a simplicity strange enough in one of his mental stature, he actually believed that by building the Dreadnought he was putting a spoke in Germany's wheel, because that country possessed neither the technical facilities nor the money to build battleships of equal size and strength. How sadly he miscalculated is now ancient history. Germany not only adopted but improved upon the British prototype. The cancelling of the great British pre-Dreadnought fleet of forty units—two to one against Germany—enabled Germany to start fair in the new building race, and how well she took advantage of this heaven-sent opportunity was demonstrated at the Battle of Jutland.

REVERTING to the gulf between Admiralty and "left wing" views just after the war, it may interest American readers to know that the intervening years have brought about a compromise, with the result that, at a conservative estimate, three British naval officers out of five now think alike on problems of material. The main heads of agreement may be summarised as follows:

1. Battleships are essential to British naval requirements, and they must carry guns of 3 or 4-inch greater caliber than those of contemporary cruisers.

2. Provided other powers agree (but not otherwise) the future battleship might safely be standardized at 22,000 tons, with 11-inch guns. The displacement mentioned is the least

*Author: "The Great Pacific War, 1931-1933" (1925); "Navies and Nations" (1927); "Sea-power in the Pacific" (1921); "Strange Intelligence; Memoirs of Naval Secret Service" (1931).

on which it is possible to embody adequate protection against attack above and below water.

As regards cruisers, the British view is that their functions can be efficiently performed by ships of 7,000 tons, armed with 6-inch guns. The 10,000-ton, 8-inch gun type has fallen into disrepute as a hybrid born of political expediency rather than strategical necessity. It is also condemned on account of its extreme vulnerability. No cruiser of this type could endure the punishment to which it would be exposed in action, and apart from other considerations informed opinion revolts against the idea of sending 700 officers and men into battle in a ship liable to be totally destroyed by a single well-placed salvo or a single torpedo or mine. To avoid misunderstanding, I should state that I am now quoting British expert criticisms (Sir William J. Berry, ex-Director of Naval Construction, and Sir George Thurston, an eminent naval architect) of the British 10,000-ton class, and that they apply to vessels of this type under foreign flags only insofar as the whole family of "Washington Treaty cruisers" is subject to the same inherent defect of vulnerability, due to the paramount claims of high speed and heavy armament which allow but a meagre margin for armor and underwater defense.

Any one with a knowledge of naval artillery, be he professional or layman, can sympathize with the arguments of the biggest-gun enthusiast. Other things being equal, the biggest gun is the best. It can shoot further, drill thicker armor, and detonate with greater violence than its smaller brothers. But since we cannot divorce the gun from its platform, it follows that the size of the gun determines the size of the ship. Modern methods of fire control demand a multiple battery. In rare instances (e.g. the British battle cruisers RENOWN and REPULSE and the German armored ship DEUTSCHLAND) a broadside of six guns has been accepted, which means in practice a three-gun salvo for ranging purposes. This number is generally regarded as insufficient, four guns per salvo being the minimum necessary to secure good "bracketing." The ideal ship must therefore carry not less than eight heavy guns. If these are to be of 16-inch caliber, and if at the same time the vessel is to have adequate speed and armor defense, we are at once committed to a displacement of not less than 30,000 tons and probably more. On the other hand, by reducing calibers we can effect a substantial saving in tonnage. Thus, roughly speaking, eight 14-inch or 13½-inch guns could be mounted satisfactorily in a ship of 27,000 tons, eight 12-inch in one of 24,500 tons, and eight 11-inch in one of 22,000 tons.

WE may now consider the factors that determine the choice of a capital ship's main armament. Foremost among these is the size of the guns mounted in the battle fleets of other powers. If, for example, the existing limit of 16 inches were retained, and it was intimated that one or more of the Treaty signatories proposed to arm its future ships with ordnance of this caliber, the other powers would virtually be compelled to mount guns of approximately equal weight. Great Britain has announced her readiness to restrict the gun caliber to 11 inches, but with the proviso that this becomes the international standard. She could not and would not build 11-inch gun ships if other nations continued to build 16-inch gun vessels. There is, however, no particular reason why mathematical parity in calibers should be observed. The difference in power between 16 and 15-inch guns, 14 and 13½-inch, or even 12 and 11-inch, is not sufficiently marked to foredoom the lesser caliber to defeat. If the Battle of the Falkland Islands demonstrated the futility of opposing 8-inch to 12-inch guns, Jutland seemed to prove that 11-inch and 12-inch weapons, skilfully served and mounted in strongly-armored ships, are able to hold their own against much heavier ordnance. It is true, however, that the conditions in the Jutland action were somewhat peculiar—for instance, the inadequate protection of certain British ships was largely responsible for the spectacular results of the German shooting—and it would be unsafe to draw hard and fast conclusions from a single encounter.

Other factors are accuracy, range, penetration, and explosive capacity. As is well known, the heaviest gun is the most accurate at very long ranges. This inevitably raises the question as to the ranges at which future naval actions will be fought—and decided. On this point the experts differ. In the long discussion which preceded the United States Government's decision to increase the angle of gun elevation in its older battleships it was categorically stated that 35,000 yards might well prove to be the decisive range in a future war. Now decisive range means, of course, the distance at which hits become numerous enough to destroy or disable the enemy. British expert opinion, so far as it is articulate, appears to consider something between 22,000 and 25,000 yards as the extreme range at which regular hitting is likely to be established, and then only in perfect weather conditions.

During the World War the longest range at which a hit was ever made by one ship on another was 21,000 yards. This was when the 5th Battle Squadron (four "Queen Elizabeths," mounting 15-inch guns) was engaging the German battle cruisers at Jutland. It is interesting, if somewhat irrelevant, to recall that in an action between British monitors and the German coast defences in Flanders, the slow-moving British ships were several times straddled by a 15-inch battery at a range of 32,000 yards. We can all take off our hats to such shooting as that, even allowing for the shore battery's advantage in respect of stable platform, observation balloon spotting, and the meticulous antecedent plotting of the whole area commanded by the shore guns in question, up to their extreme range. That these conditions could never be reproduced at sea goes without saying.

HAVING witnessed a number of shoots from British warships in the North Sea and the Mediterranean, and from guns of every caliber now mounted, I shall venture to inject a layman's opinion into this highly professional controversy—my apology, if it is needed, being the old tag about "the onlooker seeing most of the game." That opinion is that in any save quite abnormal conditions naval guns of the present type, controlled by the best methods now known, are never likely to establish decisive hitting at any range beyond 24,000 yards. This is not to say that hits above that range will never be made, but that if the target be struck at all it will be only by isolated shots in the nature of "flukes."

Granting good weather conditions and high visibility, two opposing fleets might well be tempted to open fire at the extreme range of their guns, each hoping to inflict some material and moral damage at the outset. But unless a reasonable percentage of hits were obtained at this stage it is more than likely that after the first few salvos firing would be suspended until the range had closed. No prudent admiral would care to squander his precious ammunition on a chancy game of long bowls, for it must not be forgotten that the usual quota of ammunition in a modern battleship is only about eighty rounds per gun. On the other hand, if one fleet

opened fire at extreme range the other would be practically compelled to reply, if only to sustain the morale of its personnel. All officers of war experience agree that the most highly-disciplined crew is apt to show signs of nervousness if their ship comes under fire and its own guns remain silent. Thus a psychological argument could be added to the many which have been propounded in favor of giving naval guns the greatest practicable range.

We come now to penetration. Most of the capital ships afloat today are heavily armored over their vital parts, and in view of war lessons it is probable that the percentage of armor to total displacement will tend to increase rather than diminish. Consequently the guns of the capital ship must be sufficiently powerful to drive their projectiles through fairly stout armor at moderate ranges. Here, of course, the biggest gun enjoys an indisputable superiority, which must, however, be weighed against the disadvantages already catalogued. Nor does it follow that penetration of her thick waterline armor is necessary to bring about the destruction or disablement of a ship. Analysis of all accessible data reveals the interesting fact that, with possibly two exceptions (Indefatigable and Lützow) no capital ship at the Battle of Jutland was put out of action by the perforation of her side armor.

The most fatal hits were those registered on turrets. These caused the loss of the Queen Mary, the Invincible and, most probably, the Defence. In the case of the Indefatigable the evidence is conflicting, the balance favoring the theory of coincidental hits on a turret and a section of armor deck above a magazine, the deck being pierced. As regards the German battle cruiser Lützow, which sank during the night, her gunnery officer has since ascribed her end to two 12-inch shells, fired from the Invincible, which penetrated below water forward at a point just ahead of where the longitudinal torpedo bulkhead terminated. Here, however, the armor cannot have been of any great thickness, probably 6 inches at most. In H. M. S. Princess Royal the 9-inch side armor was at one place completely drilled by a German 12-inch shell. This is believed to be the only example in the whole action of thick armor being cleanly perforated. But in a number of ships armor plate was fractured, or driven in, or torn off by the impact of shells, the damage often being quite as serious as complete penetration. Thanks to their excellent fuzes the German shells were usually very destructive when they did get through. In this respect the British projectiles as a whole were inferior, though sometimes they were deadly, as when successive hits by 15-inch gunfire completely wrecked and burnt out two of the massive-plated turrets of the Derfflinger.

FUZE and burster are, it goes without saying, vital elements in the efficiency of the naval projectile. During the war the Germans enjoyed a marked advantage in both respects. They had taken endless trouble to produce a thoroughly reliable armor-piercing shell, and their efforts were richly rewarded. A full account of how this formidable projectile was developed has since been published in the German technical press. In the British Navy the large-caliber shells of the war period left much to be desired. For the armor-piercing type lyddite proved too sensitive a filling, and for some reason the more stable but highly effective TNT was not adopted till a later stage. Consequently the A.P. shell fired by the 15-inch gun, the most powerful and accurate weapon in the Grand Fleet, was loaded as a rule with ordinary gunpowder, and the effects of its burst were correspondingly limited. Of these shells a German officer whose ship was frequently hit by them writes: "Their impact had the full force of their large caliber; wherever they hit there was a violent shock, but the effect of the burst was small."

Since Jutland great progress has been made in the improvement of the naval gun projectile; indeed, development on these lines began immediately after a study of battle data had revealed the shortcomings of the British shell then in use. The following passage is taken from Earl Jellicoe's book, "The Grand Fleet," his own italics being retained:

"The Jutland battle convinced us that our armor-piercing shell was inferior in its penetrative power to that used by the Germans, and immediately after the action I represented this with a view to immediate investigation. . . . With one of the old type of A.P. shells of a particular caliber as used at Jutland the shell would, with oblique impact at battle range, *break up whilst holing a certain thickness of plate,* and the shell could not, therefore, reach the vitals of the enemy's ships. A shell of the new type and same caliber, as produced by the 1917 Committee, would at the same oblique impact and range *pass whole through a plate of double the thickness* before exploding, and could therefore, with delay action fuze, penetrate to the magazines of a capital ship. Had our ships possessed the new type of A.P. shell at Jutland, many of the enemy's vessels, instead of being only damaged, would probably not have been able to reach port. The manufacture of these new type shells for the Fleet was well advanced before the end of 1917."

The pertinent question as to why the British Navy was not supplied with efficient A.P. shell *before* Jutland remains to this day unanswered. The fact that all the German dreadnoughts were exceptionally well-armored must have been known to the British naval authorities, and firing tests against armored targets would have disclosed the shortcomings of the pre-war type of shell. Apparently such tests were not held, though in the German service they were a matter of routine. British gunnery policy before the war was apparently based on the theory that no ship, however stoutly armored, could long endure the blasting effect of high-explosive attack. This theory, in turn, dated from the Battle of Tsushima, when Russian ships were destroyed wholesale by Japanese shell having thin walls and a heavy charge of shimose—a compound resembling lyddite or mélinite. But the targets on this occasion were to a great extent unarmored. The standard Russian battleship of 1904-05 had a thick but very narrow belt on the waterline, often submerged at full load. Above this belt the sides had only scanty armor or none at all. In consequence a vast area of the hull lay exposed to high-explosive attack, a fact of which the Japanese intelligence department doubtless had full knowledge.

But the German battleships at Jutland were very different targets. They were armored on scientific principles which rightly discounted the effect of mere blast on solid structures and aimed to defeat penetration by high-explosive shell. Those principles have since become universal as regards capital ships, though they have been completely ignored in the design of post-war cruisers. It is easy to picture the delight of a gunnery officer who sees before him the towering hull and naked sides of a 10,000-ton "Washington Treaty" cruiser, and the gusto with which he orders his turrets to load with common shell.

An unofficial plebiscite taken not long ago among my acquaintances in the British Navy showed a striking con-

sensus of opinion as to the requirements of a future battleship, assuming the standard displacement to be fixed at 25,000 tons. With very few exceptions they voted for a main battery of eight 13.5-inch guns, a secondary armament of twelve to sixteen 6-inch, and the strongest armor protection consistent with reasonable speed—21 knots was the most popular figure—and cruising endurance. Few saw any reason why such a ship need hesitate to engage a 35,000-ton, 16-inch gun opponent. To quote one of the replies: "We (that is, the 25,000-ton 13.5-inch gun unit) could open fire at any range up to the limit of visibility; we should be firing more rapidly, and thanks to this would probably get on to the target first. Once hitting was established our 1400-pound shell would do all that was necessary."

TURNING now to the secondary armament of capital ships, it is generally conceded that the 6-inch is the smallest gun for this purpose, nothing less being capable of stopping the modern destroyer. Moreover, unless these guns have good armored protection they and their crews are liable to be knocked out in the early phase of an engagement, leaving the ship incapable of effectively resisting a later destroyer onslaught. The modern tendency is to mount the secondary guns in closed turrets, stout enough to resist the deadly hail of splinters if not direct hits. Open shields were proved by the war to be death-traps. Objection is raised in some quarters to placing these guns in turrets on multiple mountings because, it is argued, their speed of fire and unique facility of handling is thereby reduced. The answer to this is that the prime necessity is to keep one's guns intact. In the battleship MALAYA at Jutland the entire starboard 6-inch battery was put out of action by two German shells which started a cordite fire, the guns being inadequately isolated one from the other by partial screens. Had they been mounted in turrets, or even in a properly bulkheaded battery, the disaster could not have occurred. Concentration may, however, be carried too far. In the new French battle cruiser DUNKERQUE the secondary armament of sixteen 6.1-inch guns is housed in quadruple turrets. In these circumstances interference between the gun crews, with a consequent reduction in rate of fire, will be difficult to avoid.

Several recent capital ships and cruisers in all navies have their secondary armament adapted for high-angle fire against aircraft. This, as every student of gunnery knows, involves serious complications in loading, sighting, and fire control, and it remains to be seen whether the innovation is worth while. The problem of antiaircraft gunnery is still far from solution. So far as personal experience goes, antiaircraft artillery in its present form cannot be depended upon to stop a really determined attack by high-speed bombing machines, though it would probably be able to repel torpedo-planes. It is impossible to determine with any precision the offensive potentiality of aircraft against men-of-war. In any case, it is not the business of ship and ordnance designers to indulge in speculation on such matters. Since the competent naval authorities in Europe, the United States, and Japan all regard the capital ship as the backbone of sea power, we may take it that the type will persist well into the future—until, indeed, its value is definitely disproved by the acid test of war.

The gun, therefore, remains at the head of the naval armory, and its development is consequently a matter of vital importance. Since calibers are restricted by treaty, progress must be confined to metallurgical research and processes of manufacture, with a view to prolonging the life of the gun and increasing its accuracy; to the improvement of loading gear with the aim of achieving a very high rate of fire; to the perfection of fire-control methods, and to the production of still better projectiles. All these lines of research are hampered by the prevailing financial depression, but in spite of this it would probably be found, if admiralties could afford to be communicative, that a considerable advance in naval gunnery technique has been made in the past ten years.

Assuming a common standard of accuracy, rapidity of fire promises to be the decisive factor in the naval combats of tomorrow. Above all, since only practice makes perfect, the maintenance of gunnery efficiency demands frequent shoots under conditions approximating as far as possible to those of war. The irony of the situation is that the exorbitant cost of ammunition for the modern big naval gun militates against frequent battle practice. It is to be doubted whether the main armament of any battleship now afloat is in action, with full-caliber charges, for more than fifteen minutes in the year.

Battleships of the U. S. Navy at Target Practice.

Consider the Manufacturer

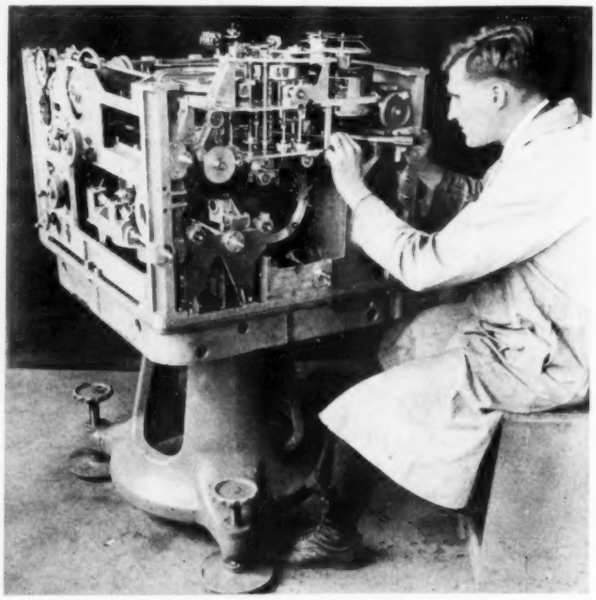
His Essential Place in the Preparedness Plan

By Earl W. Chafee*

ARTICLES in recent issues of ARMY ORDNANCE have made it somewhat easier to prepare this discussion because they have departed from the usual complimentary tone and have presented the opinions of the writers in a manner which shows that we do not all agree that our so-called solutions are 100 per cent perfect. The procurement of the equipment necessary for proper antiaircraft defense is certainly not one of the perfect programs. The following discussion is not set up as a cure-all, but simply as the writer's opinion formed after many years' experience in the design and manufacture of fire-control equipment and also the manufacture of such equipment under war-time conditions.

Until very recently the tendency has been to overlook the part that the manufacturer plays in the development of a procurement program for specialized manufacture. Our military organization, like that of many other countries, has been brought up in a school of thought which taught its members to believe that all special equipment intended for military purposes could only be designed and manufactured by personnel trained in the military service or, in other words, that all designing must be strictly in conformance with specifications written by military officers and all manufacturing carried out along lines formulated in arsenals or navy yards. There is no argument with this line of thought as applied to 50 or even 25 years ago but it is evident that now the whole situation has changed. We realize now that not only must manufacturing facilities be built up which go far beyond the Government-owned plants, but that design and research facilities must also be built up outside the military services. This is in no way a criticism of the officers of the regular service connected with the development of these products. The situation is a natural result of the progress made in all lines of mechanical equipment. Today is the age of specialists and it cannot be expected that those who are specializing in military tactics will also be specialists in the manufacture of intricate mechanical instruments.

Our military services quickly took steps to formulate plans for meeting the demand for quantity procurement. The change-over in policy has, of course, resulted in some confusion, but as the question of procurement has been brought to the foreground, it has become necessary to actually bring forward a new line of thought in the design of military equipment.



Specialized Manufacture in its Highest Terms—Assembling an Antiaircraft Director.

TO appreciate the importance of this new line of thought and to bring it within the recollection of all of us, and let us summarize the change in conditions during the last twenty years, and let us compare pre-war and post-war requirements.

Even though quite a few firms were engaged in the manufacture of ordnance equipment before the United States entered the World War, most laymen thought—and even many officers connected with procurement thought—that the manufacturing capacity of our Government-owned plants or subsidized plants was ample to fulfill all our requirements in times of emergency. It took but a few days after our entrance into the war to realize that this was far from true and therefore today the program with which the Army Ordnance Association is concerned is one of the mobilization of the entire manufacturing resources in time of an emergency.

Admitting that this is true, let us seek a plain and simple reason why it should be true. We immediately find that the problem can be reduced to a very simple statement of fact, namely, the quantity required. It is not at all necessary to discuss the reasons for the requirement of munitions in immense quantities, as they are self-evident. After our experiences during the last war, there is one thing of which we may be certain and that is that the requirements of procurement in the next emergency will certainly not be less.

The second and equally important reason why it has been necessary to bring the manufacturer into the procurement program is one of funds. During the pre-war period the development of any special line of equipment, except in a few instances, was more or less dependent upon Government requirements and we need go back but a few years farther until we find that the beginning of most any industry was connected in some way or other with Government assistance in a direct financial way. I do not mean to infer that there are not industries or developments, still, where Government financial assistance is required, but the immense strides made in the development of manufacturing processes and the large amount of work done by commercial organizations in the research necessary to bring these developments about have created an organization outside of the Government depart-

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ments which is self-sustaining and the financing or subsidizing of which would stagger even our budget officers. On the other hand, instead of being able to take on this additional burden, our Government departments are faced with the problem of retrenchment and so the funds available for the development of new processes are more liable to be reduced than increased. We realize that keeping ahead or even abreast of the development of all things classed as war-time material is therefore one of immense cost and it is only another step to visualize that the procurement of this material in time of emergency must be a tremendous task. This brings us back to the point in question, that of designing ordnance equipment along the simplest lines possible in order that it may be capable of quantity procurement at the minimum of cost.

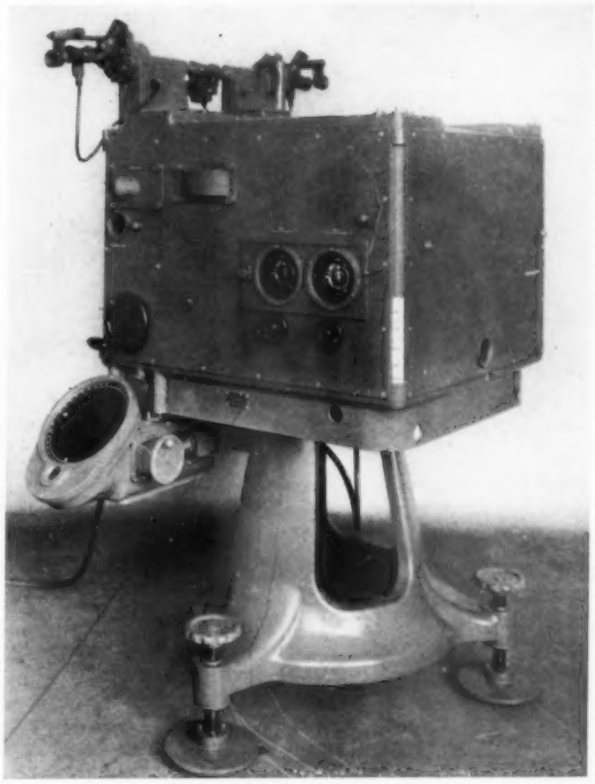
This very positive change in policy is not satisfactory to the using services nor is it satisfactory to the designing engineer, whether such engineer is connected with the service or engaged in a commercial line. We have therefore found a new specialist rapidly coming to the front. While I do not know what to call him, I do know what his duties are, namely, to reconcile the desire for perfection in theoretical design with the practical from the standpoint of quantity production.

AS a member of the Specialist Reserve of the New York Ordnance District I am directly concerned with the relation of that organization to the question of procurement of ordnance matériel, and quote from the National Defense Act to show that this question of wartime procurement is definitely a part of the plans of our Government: "The Assistant Secretary of War, under the direction of the Secretary of War, shall be charged with supervision of the procurement of all military supplies and other business of the War Department pertaining thereto, and the assurance of adequate provision for the mobilization of matériel and industrial organizations essential to wartime needs."

The primary function of any Ordnance District is to organize the industries of the District in readiness to produce ordnance of proper quality in sufficient quantity and within a minimum of time, all to the end that a threatened emergency may be averted or an existing emergency terminated on a satisfactory basis within a minimum of time.

We recognize that the commercial organizations are carrying out large plans for the improvement in manufacturing processes with the result of increase in quantity and decrease in cost, but it must also be recognized that although all of these developments are interconnected there are certain detail developments which necessarily are still somewhat restricted to military demands. These specialized developments, however, must be a part of the general preparedness program if they are to be required in any quantity, and it is one of these developments, namely, the antiaircraft director, which will be described later in detail both as to its history and its relation to the procurement program.

Let us analyze first what it is that has brought the antiaircraft director to the foreground in all military plans and why all nations recognize that its procurement in quantity is highly desirable and probably absolutely vital. The probability of aircraft attack is no longer one of theory, but the realization that attacks will take place has been brought home to everyone within the last few years. There are several methods for defense against aircraft, but no matter what other defenses are provided for in our plans, we must also include the antiaircraft battery and for the purposes of this article we will confine the discussion to that means of protection.



The Assembled Antiaircraft Director.

Gun batteries defending a large city or manufacturing center may attempt its defense along the line of what we may call a barrage and put enough bursting shells in the air to turn back approaching bombers, but under this circumstance the question becomes one of the quantity of ammunition for the battery versus the amount of gasoline available for the attacking squadrons.

Again, the question of morale enters in as it is disturbing, at least, to have airplanes continually appearing in the air and making feints at an attack, keeping everyone in the frame of mind that sooner or later the squadron will get through. On the other hand, if instead of a barrage of large amounts of ammunition we equip these batteries with antiaircraft directors which suddenly open up on an attacking plane with either direct hits or bursts sufficiently close to be immediately a source of danger, then we put the shoe on the other foot and the morale of the attacking force is lowered and the morale of the defended area vastly improved.

Another important point directly connected with this program is that attacking planes give very little warning of their approach and it is essential that all important centers be protected by some means which can be swung into action almost instantaneously. In these centers we must include nearly everything justifying protection, as with the present day bomber there is no way of predicting where the attack may occur and the quest. n of distance from the base of the attacking force has well-nigh been eliminated.

Of course any country at war or on the verge of an emergency attempts to maintain absolute secrecy as to its military

plans and specialized military equipment, but at the present time when all matters pertaining to armament are supposed to be an open book, we have found that secrecy as to details may be maintained for only a short period, say two years, and during these two years about all that is accomplished is the study and the development of a few test equipments. As soon as such specialized equipments are recognized as successful, the results of the tests and more or less of the theory become known to the military world at large. The question of secrecy in any equipment required in quantity therefore has ceased to be of paramount importance, and because of this another change in policy has been inaugurated by our War Department in order to further the working of the plan for securing quantity production.

As previously stated, many of these instruments require special manufacturing provisions and therefore necessarily require experience in an organization which proposes to produce them in quantity. It is evident that no manufacturing firm can enter into this program of quantity production to any great extent without making it as near as possible self-supporting. It is easy, therefore, to understand that under the international program of retrenchment in armament no nation can purchase from its manufacturing source of supply in sufficient quantities to justify the manufacturer in setting up to meet the requirements of the emergency program, and therefore these conditions have led to the adoption of a new policy. To understand this policy let us assume that some nonmanufacturing country has determined that it is necessary for the protection of its nationals to purchase and install a certain number of antiaircraft gun batteries. It is well recognized that these gun batteries are more or less a gesture unless they are provided with modern fire control, and therefore it becomes necessary for this nation to purchase fire control. Naturally it is desirous of purchasing that equipment which will give the maximum of protection, but if it is not permitted to use one source of supply it will purchase from some other source.

These nonmanufacturing countries are in rather an unenviable position at the present time because of the talk of disarmament coupled with the further talk of prohibiting the purchase of any military equipment after the beginning of hostilities. In other words, they are not in a position to manufacture after an emergency and cannot put themselves in such a position, and they are not allowed to buy from any other source after an emergency arises, with the result that they must either make up their minds to go totally unprotected or secure their protection before there is any question of an emergency being imminent.

Assume, therefore, that these countries are to be prepared in advance and are forced to provide for a current purchasing program covering the essentials of protection against air attacks. The question arises, where is it advisable to purchase this equipment, and we find another important point influencing their decision. It is immediately evident that the country receiving the order for equipment will benefit as well as the country purchasing the directors, because in the latter case they have a small quantity on hand but no provision for additional procurement whereas the country receiving the manufacturing order becomes provided with facilities for the manufacture of an equivalent number in a very short time. Again of interest to the military departments, the country which supplies directors is thoroughly aware of the type and quantity of the equipment of the purchasing country and also knows that a purchasing or a nonmanufacturing country does not have the means for increasing its equipment except in the open market. It also goes without saying that the country which is selling, is continually improving its equipment and therefore always has at its disposal the very latest in type which, in accordance with our previous assumptions, may be the equivalent of up to two years of progress.

The foreign purchaser under the old policy could purchase only out of date equipment and it is sometimes difficult for him to understand this new policy which now permits him to secure the most modern standard equipment developed by private manufacturers.

It is evident that any country which can put itself into the position of being the source of supply for the world at large is definitely building up a program of protection. It is because of this self-evident fact that our War Department has encouraged our manufacturers in securing such foreign orders as actually build up manufacturing resources, reserving at all times the right to restrict such sale to nations not considered potential enemies and always bearing in mind that in each case there must be a gain to our own national defense.

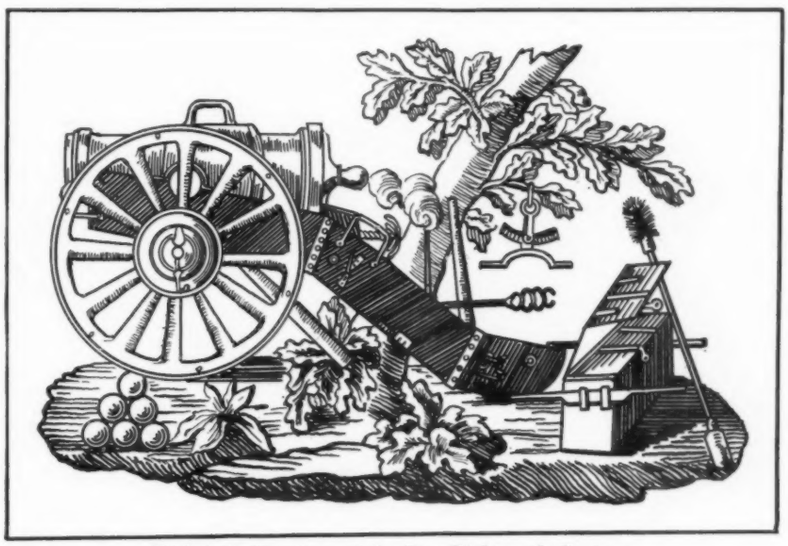
Sperry Antiaircraft Directors in the Assembly Line.

Early History of American Ordnance

A Chronology of Munitions Supply in the United States, Part I

By Brig. Gen. William H. Tschappat*

THE history of Ordnance in the United States begins with the appointment by the Continental Congress on May 27, 1775, of a committee to consider ways and means to supply the colonies with ammunition and military stores. In the Act of June 15, 1775, which placed George Washington in command of all the military forces of the United Colonies the Congress authorized him to appoint a new officer called Commissary General of Artillery Stores. Ezekiel Cheever was appointed to this position on August 17, 1775, and became the nucleus around which there gradually grew up a corps of officers and civilians assigned to Ordnance duty exclusively. The designation was later changed to Commissary General of Military Stores. The Continental Congress then, as our Congress now, took a great interest and an active part in Ordnance matters. Committees and individual members of Congress negotiated contracts for powder and other ordnance supplies throughout the war, delivering them either directly to the Commander-in-Chief of the Army or to the Commissary of Artillery Stores.



Eight-inch Howitzer of the Late Eighteenth Century.

One step to further the procurement of ordnance matériel was the appointment by the Congress, September 18, 1775, of what was known as the "Secret Committee," consisting of nine members of Congress, for the purpose of procuring powder, artillery, muskets and other armament.

I am referring now to the early days of the American Revolution. The initial rebellion of the Colonies against England had taken place but the Declaration of Independence had not yet been signed. There was not yet a War Department. Military functions of the United Colonies were handled direct by the Congress or by the Commander-in-Chief.

On June 12, 1776, the Congress created the "Board of War and Ordnance," to consist of five members of Congress. This board was to "obtain and keep an exact copy of all the artillery, arms, ammunition, and war-like stores belonging to the United Colonies, and the manner in which, and the place where, the same shall from time to time be employed; and that they shall have immediate care of all such artillery, arms, ammunition and war-like stores, as shall not be employed in actual service; for the preservation whereof they shall have the power to hire public magazines at public expense."

In these two organizations, viz., the Secret Committee and the Board of War and Ordnance, both authorized before the Declaration of Independence, the Congress recognized the importance and indeed in those days the dire necessity of a proper organization to perform the functions of procurement, care and maintenance of ordnance matériel, and this principle is just as good today as it was 156 years ago.

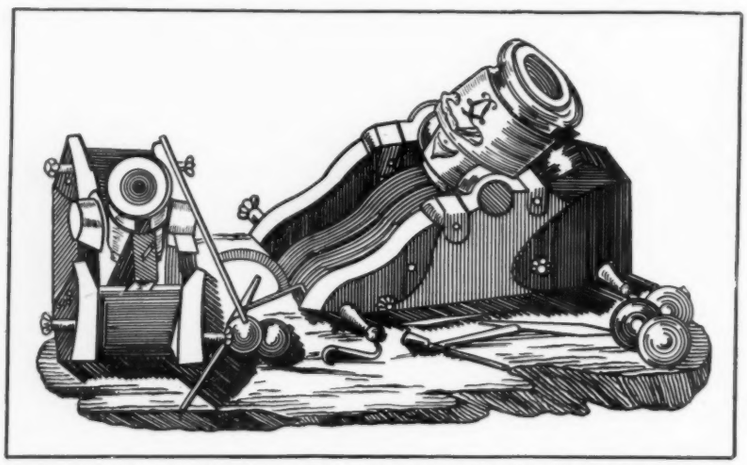
On October 18, 1777, Congress provided that the Board of War should consist of persons other than members of Congress. At this time there was a Commissary General of Military Stores, a Deputy Commissary General and several assistants Commissary General. These officers were civilians without military rank, unless they belonged to the regiment of "Artillery Artificers" which had been organized to recruit personnel to man the public armories, laboratories, foundries and military magazines. They and all these artificers were subject to the orders and command of the Commissary General of Military Stores.

WITH the organization thus authorized, the War of the Revolution was fought. Let us now see what it was able to procure and accept for the Army, and how it looked after care and maintenance. Early in the Revolution England had, of course, shut off the exportation of arms and ammunition to the Colonies. Some arms were available but the question of ammunition, particularly powder, at once became urgent. Steps were taken to have the inhabitants of each colony collect all the saltpeter and sulphur they could find and ship it to designated central points, with a view to its immediate manufacture into powder. The provincial convention of the colony of New York, which seems to have been the only colony which had powder mills, was urged "to have the powder mills in that colony put into such condition as immediately to manufacture into gun powder for the use of the continent, whatever materials may be procured in the manner above directed." The Congress agreed to pay for materials thus produced and collected "out of the Continental fund."

*Assistant to the Chief of Ordnance, U. S. Army.

The illustrations used in this article are from the famed French work, "Specifications of the Principal Artillery Weapons Proposed or Approved from 1764 to 1789, by M. de Gribeauval, Lieutenant General of the King's Army and First Inspector of Artillery; Compiled and Codified by Major General DeManson and by several other Officers of the Royal Corps of Artillery of France; Printed and Engraved by Order of the King."

Energetic steps were also taken to import powder and its components and other ordnance stores as attested by the following resolution of Congress, of July 15, 1775: "Resolved, That for the better furnishing these colonies with the necessary means of defending their rights, every vessel importing gun-powder, saltpeter, sulphur, provided they bring with the surphur four times as much saltpeter, brass, field pieces or good muskets fixed with bayonets, within nine months from the date of this resolution, shall be permitted to load and export the produce of these colonies to the value of such powder and stores aforesaid, the non-exportation agreement notwithstanding; and it is recommended to the committees of the several provinces to inspect the military stores so imported, and to estimate a generous price for the same, according to their goodness, and permit the importer of such powder or other military stores aforesaid to export the value thereof, and no more, in produce of any kind."



Cast Iron Mortar and Carriage of the American Revolutionary War Period.

Congress was not averse to direct action in regard to the Army itself, as shown by the following resolution of October 5, 1775: "Resolved, That a letter be sent to General Washington to inform him that Congress having received certain intelligence of the sailing of two north-country-built brigs, of no force, from England on the 11th of August last, loaded with arms, powder and other stores, for Quebec, without convoy, which it being of importance to intercept, desire that he apply to the council of Massachusetts Bay for the two armed vessels in their service, and dispatch the same, with a sufficient number of people, stores, etc., in order, if possible, to intercept the said two brigs and their cargoes and secure the same for the use of the continent; also any other transports laden with ammunition . . . for the use of the ministerial army or navy in America, and secure them in the most convenient places for the purpose above mentioned."

Later in the same year a resolution of Congress recommended to the several assemblies or conventions of the colonies that they set their gunsmiths to work and it is interesting to note some of the characteristics of the muskets they were to make: bore ¾ inch, length of barrel 3 ft. 8 inches, bayonet 18-inch blade. Provision was also made that arms of soldiers leaving the service be taken over for the use of the Army on a valuation made of them.

Although the Secret Committee was organized with the authority of Congress for the purpose of importing or otherwise procuring ordnance, it seemed to require the authority of the entire Congress if large procurements were to be made. On November 20, 1775, the Committee was empowered to contract for the importation of a hundred tons of lead. On January 3, 1776, Congress resolved that the following stores should be imported at once, and authorized the Committee to take the necessary measures: 20,000 stand of arms, 300 tons of lead, 1,000,000 flints, 1,500 boxes of tin and wire, and 500 sheets of copper.

ON January 15, 1776, a separate committee was appointed to make an estimate of the number of cannon that may be wanted for the defense of the United Colonies and to devise ways and means for procuring them, and that it be an instruction to said committee to inquire what size cannon can be cast in these colonies. The duties of this committee on artillery seem to have paralleled for artillery those of the Secret Committee for small arms and on February 20, 1776, Congress authorized it to purchase: two hundred and fifty 12-pounders, sixty 9-pounders and sixty-two 4-pounders.

In July of the same year the committee was authorized to contract with Messrs. Hughes for "one thousand tons of cannon," and in August it was directed to contract for the immediate casting of six 6-pounders, six 12-pounders, four 8-inch howitzers, four 6-inch howitzers and six cohorn mortars," to be made of brass if a sufficient quantity of that metal can be procured; if not, to be cast of iron." These, with suitable mounts, were to be sent to General Horatio Gates who was then in command of the northern army.

On August 28, 1776, Robert Towers was appointed Inspector of Powder for the *United States,* and the same legislation provided that suitable inspectors be appointed in the various colonies. The method of inspection and particularly of packing were outlined in some detail by the Congress. Each cask of powder was to be marked with the letters "U. S. A." and the initials of the inspector.

In November, 1776, Congress directed that the artillery committee confer with the Secret Committee as to the best means of procuring: one hundred 3-pounders, fifty 6-pounders, fifty 12-pounders, thirteen 18-pounders, thirteen 24-pounders, all to be of brass and to form the field artillery of the armies of the United States. (Note that the word States instead of Colonies is used since July 4, 1776.)

Later in the same month Governor Trumbull of Connecticut was authorized to place an order with the Salisbury Furnace for twenty 18-pounder cannon, and "skillful persons" were to be sent to this and another furnace to determine whether a sufficient number of cannon could be cast there to warrant expansion of the plant. Still later in that month the Secret Committee was authorized to provide arms for 3,000 horse. In December, 1776, Congress authorized the construction of two magazines, one in the Eastern States and one in the Southern States, and of a laboratory for the manufacture of ammunition.

Previous to the war considerable progress in the manufacture of small arms had been made in several colonies. There was a large demand for guns for hunting, for defense against the Indians and for sale to the Indians. In a letter sent by a Philadelphian to a member of the English Parliament in 1774, it was stated that the prohibition of the export of arms from England to the colonies, which had just been put into

effect, was of no avail as there were gun-makers enough in the colonies to produce 100,000 stand of arms within a year at 28s each.

In 1776 a Provincial gun-lock factory was established by Pennsylvania on Cherry Street in Philadelphia, under control of commissioners and with Mr. Peter De Haven as principal gunsmith. Later this factory, under Mr. De Haven as contracting superintendent, was at Hummelstown, near Harrisburg. Contracts were also made at York, Lancaster, Carlisle and elsewhere for a quantity of arms for the state. The price of a musket with steel ramrod and bayonet, according to pattern desired by Congress, was £4, 5s, but it is stated that it was very difficult to make contracts at less than £4, 10s or 15s, as materials were scarce and—note this—workmen were unwilling to quit the manufacture of rifles for which the demand was very great. However, we had low bidders in those days just as we have now, and one, John Kerlin, contracted to make muskets with bayonets at £4, 5s each!

THERE seemed to be considerable capacity as early as 1776 for the casting of brass and iron cannon. In April of that year Benjamin Loxley proposed to make for Congress brass eight-inch mortars, howitzers, cannon and shells for them. Daniel Joy, of the Reading furnace, was engaged in casting and boring 9-pounders at the rate of one daily. He appears to have had a proving ground near his plant, for it is related that he proved some of Loxley's cannon as well as his own, and that the iron cannon stood the proof better than the brass ones.

Congress early in the war requested the colonies to exempt from military service all persons employed in casting shot and manufacturing military stores of any kind. In June, 1776, the Board of War recommended that eleven men employed by Mark Bird in a cannon foundry in Beris County, Pa., be discharged from the militia. In January, 1777, Thomas Butler was appointed public armorer and directed to proceed to Philadelphia to take charge of the business in that vicinity. His pay was fixed at $3.00 per day.

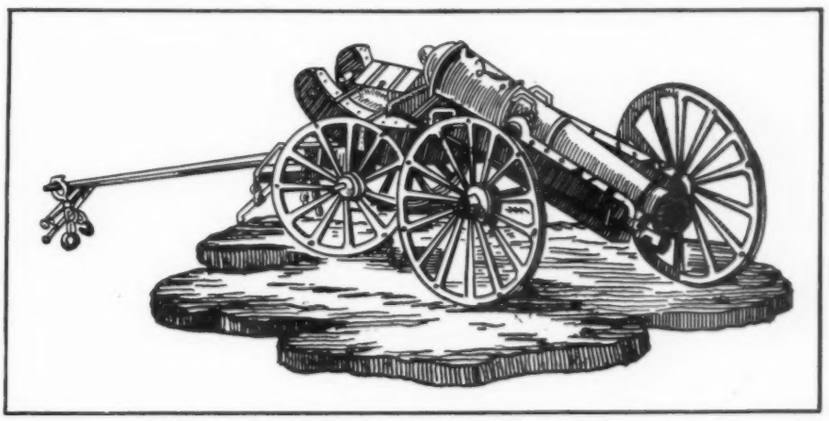
On January 15, 1778, we find a resolution of Congress authorizing a contract with Mr. Whitehead Humphreys for a quantity of steel for the supply of continental artificers, presumably for use in tools. This was to be made at the Andover works in New Jersey. Note that almost a century elapsed before steel was used in the manufacture of cannon and gun carriages in the United States.

By January 1, 1778, the business of procuring ordnance material for the Continental Army had been pretty well systematized and transactions such as I have described were of frequent occurrence. The sources of supply were: *a*. Capture of enemy supplies on the high seas where practicable. *b*. Stimulation of importation of arms, powder and raw materials by masters of ships by granting them the privilege of exporting stores of various kinds if they imported ordnance material. *c*. Stimulation by every means at hand of the production of arms and ammunition in the colonies. This also included the working of iron, copper and lead mines and the conversion of ore into metal at the various furnaces.

The effect of the war in the stimulation of these industries had much to do with the lead the country took in them at a later date.

The organization which gradually grew up to handle the procurement and supply of ordnance was always comparatively simple. While authority was pretty closely held by Congress itself throughout the war it gradually divested itself of actual operation and was content merely to authorize the procurement of the items desired.

IN a resolution passed February 11, 1778, Congress outlined the organization as a whole. Briefly, there was a "Commissary General of Military Stores" whose business it was "to receive and deliver all arms, ammunition and accoutrements of every species and denomination, to provide and contract for all such articles as may be wanted in this department, according to the directions he shall receive from the Board of War and Ordnance; to receive and collect returns from all the different States where there are any continental arms and stores, draw them into one general return, and on the first day of every month deliver one to the Board of War and Ordnance."



Field Gun and Carriage (1764–1789) After de Gribeauval.

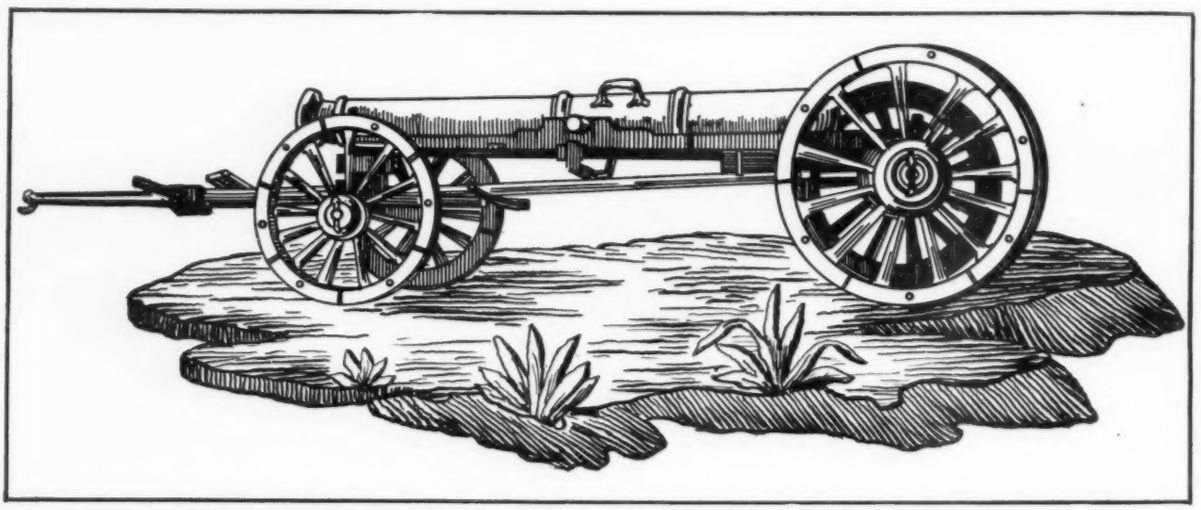
As many deputies and assistants to the Commissary General as the exigency of the service required were authorized, to be appointed by the Board of War and Ordnance. All continental armorers were under the immediate direction of the Commissary General.

One of the five regiments of artillery authorized early in the war was organized as a regiment of artificers under Colonel Benjamin Flower. This regiment of mechanics served throughout the war, mainly in the repair of ordnance matériel. In the resolution announcing this organization Congress stated: "The commanding Officer of artillery, for the time being, in the Grand Army, with the Chief Engineer, Commissary of Artillery and eldest Colonel of Artillery, or such of them as are present with the army, shall be a subordinate Board of Ordnance, under the direction of the Commander-in-Chief or the Board of War and Ordnance, for transacting all business of the *Ordnance Department* necessary to be done in the field and to have the care of all ordnance and ordnance stores at camps. . . ." The name "Ordnance Department" is here used for the first time by the Congress.

This system of having a board do administrative work in the field does not seem to have worked very well, and about a year later, on February 18, 1779, Congress revamped the

field organization of the Ordnance Department, placing the entire responsibility for Ordnance business with troops in the field upon the "commanding officer of artillery of the United States." This act also authorized a field commissary of military stores with assistants who reported to the commanding officer of artillery in the field and not to the Commanding General of Military Stores at the seat of government.

The commanding officer of artillery submitted estimates of material to be made and designs of alterations and improvements direct to the Board of War and Ordnance.



Transport Wagon for Field Guns in Use at the Time of the American Revolution.

At this time there were depots and laboratories at Springfield, Mass., at Carlisle, Pa., at Philadelphia, at West Point and in Virginia.

UPON the surrender of Cornwallis, October 19, 1781, the war practically ended, though the treaty of peace was not signed until 1783. The records of Congress for several years show great activity on the part of the government in the demobilization of the Army and the rounding-up of military stores. In a resolution, April 17, 1783, Congress directed "that immediate measures be taken for the sale of all such articles in the several military departments as may not be necessary for the use of the Army, previous to its reduction, or for the formation of magazines on a peace establishment." Samuel Hodgdon, then commissary of military stores, was continued in that office with several assistants.

Evidently the order of Congress for the sale of material was taken too seriously in some quarters, for we find a resolution a few months later forbidding the commissary of military stores from disposing of any of these stores without the express authority of Congress. On May 3, 1784, Congress directed that the commissary of military stores at Carlisle return to the City of New York the bells which had been taken from the churches and other edifices of that city.

During the entire period from the signing of peace to the adoption of the Constitution in 1787 and the subsequent reorganization of the government the Ordnance Department was engaged in demobilization and inventorying and caring for the military stores acquired during the war.

Soon after the adoption of the Constitution a committee of Congress was appointed to make full inquiry into the proceedings of the Department of War. In other words this was the first of the post-war investigations of our national history! The report of this committee was quite flattering to the Ordnance Department, and as it gives some insight into the status of the Department I quote at some length:

"9th. *Of the Ordnance Department.* This branch of the Department of War is important and interesting to the Union.

"The ordnance, arms, ammunition, and all the numerous appendages and complex apparatus belonging thereto, in possession of the United States, are highly valuable and require an incessant attention to their preservation.

"The places where they are deposited are as follows: Providence, in Rhode Island; Springfield, in Massachusetts; Mohawk River; West Point, on Hudson's River; Philadelphia; New London and Manchester, Virginia; Charleston, South Carolina.

"Besides which there are considerable quantities of shot and shells at the furnaces at which they were cast. The proportions at the respective places are specified in the returns on the files of Congress.

"The principal arsenals are at Springfield, West Point, and Philadelphia. The other places can be considered as only temporary accommodations for the stores, which are to be removed as soon as permanent arsenals and magazines shall be decided on and provided by the United States.

"By the information of the Secretary at (*sic*) War it appears that the stores are well accommodated at Springfield, in wooden buildings, except the magazine, which is an excellent one, built of brick at the public expense in 1782.

"That the powder and stores are well accommodated at West Point although the buildings, being built of wood, and the materials unseasoned, are going fast to decay.

"That the stores in Philadelphia are too much dispersed in different parts of the city, and placed in buildings illy calculated for their reception.

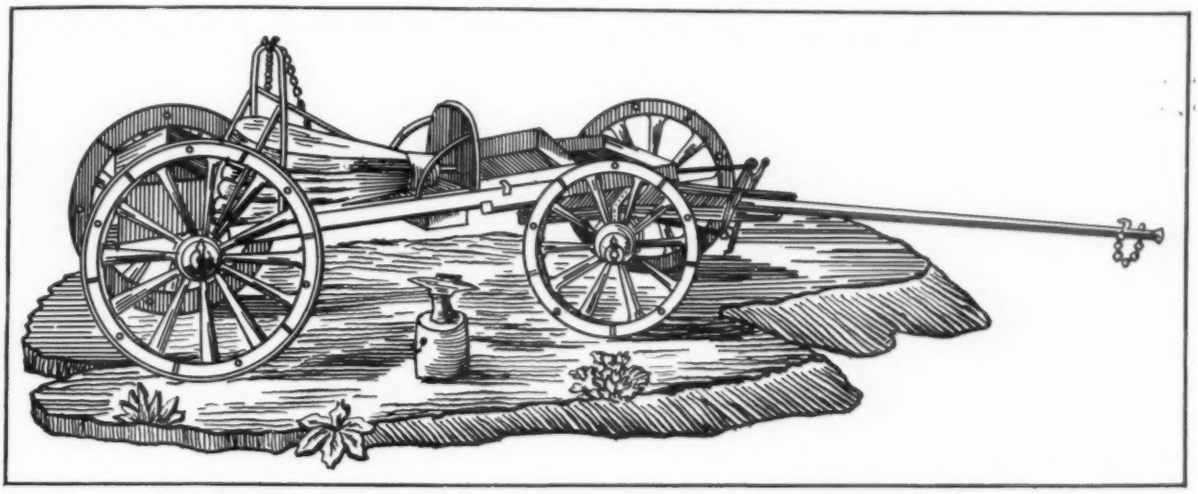
"The establishment of proper and permanent arsenals and magazines is an object of high importance and demands the serious attention of the Government of the United States. But as the expense of erecting suitable buildings for this purpose will be great, it will perhaps be thought advisable to defer it for the present.

"The arms at Springfield are new and in excellent order, the Secretary at War having had the whole taken to pieces, cleaned, and placed in racks prepared for the purpose.

"About 5,000 arms have been repaired at West Point and

are fit for immediate service. About 10,000 of the others are supposed to be worth repairing, and this necessary work is going on at that post on a small scale. To employ the number of workmen requisite to effect the business in one year would be too expensive for the public finances. These arms would probably, on an average, cost about one dollar and a half each to put them in complete order. Between 4,000 and 5,000 arms are in Virginia, the most of which require repairs.

"The new arms in Philadelphia are in such a state of repair as to need cleaning only. The Secretary at War has been



A Field Forge of the Late Eighteenth Century—Forerunner of the Mobile Repair Shop.

constrained to defer this operation until a suitable building could be obtained or an arsenal erected in which so to deposit them that they can be kept easily in order.

"The powder at Springfield and West Point, which places include the greatest quantities in possession of the public, is in excellent order. Great attention has been annually paid to this article in having it aired, cleaned, proved, well packed, and also turned frequently.

"The brass cannon and mortars are and will remain fit for immediate service, but it is to be remarked generally that no new carriages for the cannon or beds for the mortars have been made since the peace. At Springfield there are a number of new cannon carriages which have never been in service, and also at West Point there are a number fit for service, but in general the carriages which were left at the close of the war are too defective for use.

"This object will require attention when the finances of the Union will admit of replacing the carriages, without which the cannon are of little service." (*Legislative History of the General Staff of the Army, pp. 569 to 571.*)

On March 20, 1794, the President was authorized to cause to be provided one hundred 32-pounder and this same quantity of 24-pounder cannon, together with carriages for them, and for 150 other cannon and 250 tons of cannon shot. These cannon were intended as seacoast defenses of the principal harbors from Maine to Georgia.

In April an Act of Congress provided for the establishment of three or four arsenals, of which Springfield and Harper's Ferry were to be two; $50,000 was appropriated for this purpose. In the same Act Congress provided for a superintendent and a master armorer to be appointed by the President for each arsenal, and another officer at the seat of government to be appointed by the President whose duty it was to receive, safe-keep and distribute all military stores. These are essentially the same duties as had been previously held by the Commissary General of Military Stores and which were later assigned to the Chief of Ordnance.

IN this early history of the United States as a nation under the Constitution it is interesting to note the steps taken to improve the material side of defense. In May, 1798, $800,000 was appropriated for the procurement of ordnance stores, including small arms and cannon, and $100,000 additional for hiring or building foundries for casting cannon.

Congress tried many experiments at this time in attempts to improve the business organization of the government. In 1792 an Act provided that all purchases for the War Department should be made by the Treasury Department, and in 1795 an Act provided for a Purveyor of Public Supplies in the Treasury Department who would make all purchases for the government. However, after six years' trial the first Act was repealed in 1798 and the responsibility for procuring War Department supplies was placed with the chief officers of that Department, although the Secretary of War could request the Purveyor of Public Supplies to make purchases for him.

On March 3, 1803, $25,000 was appropriated for establishing one or more arsenals on the "western waters," and in 1808 the President was authorized to purchase sites for and build "such additional arsenals and manufactories of arms as he may deem expedient." So much of a preceding law as limited the total number of workmen in all the armories of the United States to 100 was repealed.

In the years following the Revolution the war-time organization of the Ordnance Department had been somewhat changed, though the government was quite active in supplying ordance matériel and in providing facilities for its manufacture and care. There was a tendency to consider the arsenals as separate and independent plants of the government, as evidenced by the appointment of superintendents and master armorers by the President. Although there was the officer at the seat of government known as the Superintendent of Military Stores whose duty it was to receive and distribute all military stores he does not seem to have had very much to do with the procurement of these stores or the administration of the arsenals.

Before we proceed with the reorganization of the Ordnance Department effected in 1812 to 1815, let us look at the principal weapons in use by the Army just before the War of 1812.

The typical army small arm which came down from the Revolution was a smooth-bore, flint-lock musket similar to the British Brown Bess of a caliber of ¾-inch. However, the French Charleville musket had also been in use and rifles of the clumsy central European type and of the much more accurate American type. This latter or Kentucky rifle used a lubricated patch around the bullet which was of a much smaller caliber than that of the muskets.

THE Kentucky rifle was developed by the Germans and Swiss who began to settle in Pennsylvania in 1683. They had brought with them heavy rifles of the central European model with a bore of nearly an inch and very slow to load. The lead ball was larger than the bore and was driven into the bore by the blows of a wooden mallet on an iron ramrod. The backwoodsman, frequently far from any base of supplies, had to economize on ammunition. This was accomplished by reducing the bore and lengthening the barrel, which latter increased the accuracy and reduced the noise, both prime considerations when we realize that during all this period there was almost continuous conflict with the Indians. Rapidity of loading was effected by the use of the greased patch around the bullet. The rifle reached its perfection by 1750 and played an important part in the Revolutionary War and later.

After the establishment of Springfield Armory as a manufacturing plant in 1793, one of its first efforts was to produce a standard type of musket. Springfield built this upon the model of the Charleville. The first Springfield musket (model of 1795) was a smooth bore flint-lock musket of caliber .69. It was produced until 1842, at which time the flint-lock was replaced by the percussion system.

We have here an excellent example of conservatism in the adoption of a new model of smooth-bore musket for the military service by the country, in which had been developed over fifty years before the superior small-bore Kentucky rifle. Notwithstanding all the demonstrated advantages of this rifle in greater accuracy and lighter ammunition, the precedent established by the use of the smooth-bore in the principal armies could not be disregarded at that time. So much for the principal arm of the infantry.

AS to artillery, the guns procured during the Revolution were mostly of the British type of artillery then in existence, although some of the French or Gribeauval type were also procured. The calibers were 1, 3, 6, 9, 12, 18, 24 and 32 pounder guns, and the same calibers of howitzers. In the case of mortars, the calibers were given in inches of bore instead of weights of bore. Of these some were made from 4½ to 16 inches. The metal of the early artillery was brass or bronze, both in those which were obtained abroad and in those manufactured here, but experiments were early made with cast-iron guns in this country, and some of those obtained abroad were also cast iron, so there was a mixture of iron and brass guns in use. The gun mounts were wooden construction generally with block trail, all parts reinforced with wrought iron. Cast iron axles early commenced to be used, first reinforced with wood and later not so reinforced. In about 1801 the decision was reached to stop the manufacture of brass guns and to use cast iron in future construction. This policy was reversed about 1836, but during the intervening period practically all the ordnance constructed was of iron. Artillery at that time was of the mobile and garrisoned type; the distinction was not so much in caliber as in method of mounting. The mobile gun was mounted to be fired from its own carriage, while the garrisoned gun required a traveling carriage for its transportation.

I WILL now revert to the reorganization of the Ordnance Department, contained in the Act of May 14, 1812, and various Acts to that of February 8, 1815. We have noticed that in the period after the Revolution a centrally controlled organization for the performance of ordnance work seems to have gradually disappeared. It is true that Congress made appropriations for ordnance material and for the construction of arsenals, but the arsenals when established appeared to be separate and independent plants without much coördination, their superintendents reporting direct to the Secretary of War or through a superintendent of military stores, who appears in the records to have been an aide to the Secretary of War for this purpose.

Matters got to the state where it was difficult for anyone at the seat of government to be certain just what ordnance there was in existence, where it was located and what was its condition. The Acts here referred to organized the Ordnance Department in much its present form. Quoting from the Act of February 8, 1815: "That it shall be the duty of the colonel of the Ordnance Department to direct the inspection and proving of all pieces of ordnance, cannon balls, shot, shells, small arms, and side arms, and equipments procured for the use of the armies of the United States, and to direct the construction of all cannon and carriages and every implement and apparatus for ordnance, and all ammunition wagons, travelling forges, and artificers' wagons, the inspection and proving of powder and the preparation of all kinds of ammunition and ordnance stores. And it shall also be the duty of the colonel or senior officer of the Ordnance Department to furnish estimates, and, under the direction of the Secretary for the Department of War, to make contracts and purchases, for procuring the necessary supplies of arms, equipments, ordnance, and ordnance stores."

The duties thus assigned to the colonel of Ordnance practically covered the duties of the Ordnance Department, insofar as the procurement and production of matériel is concerned, until the outbreak of the World War.

Quoting further from the same Act: "That to insure system and uniformity in the different public armories they are hereby placed under the direction of the Ordnance Department. And the colonel of the Ordnance Department, under the direction of the Secretary for the Department of War, is hereby authorized to establish depots of arms, ammunition, and ordnance stores in such parts of the United States and in such numbers as may be deemed necessary." This, in effect, placing all Ordnance arsenals and depots under the colonel of Ordnance, established a system which has continued to this very day.

Mechanics and laborers employed by the Ordnance Department, though not regularly enlisted, were at this period paid monthly wages and were given rations and a clothing allowance, the latter being the same as that allowed to privates of Infantry in the Army of the United States. Master armorers received $30 per month and 1½ rations; wagoners, carriage makers and blacksmiths $16 per month and 1½ rations per day; the pay of artificers was $13 per month and one ration, and of laborers $9 per month and one ration.

The Ordnance Department operated under the above Act until 1921, when a further change was made which will be described later. (*To be concluded in the July-August issue.*)

Automatic Firearms

Mechanical Principles Used in the Various Types, Part II

By J. S. Hatcher*

RECOIL OPERATED GUNS: I mentioned in the preceding part of this discussion that the first machine gun, the Maxim, was recoil-operated, and that the barrel moved back about three-quarters of an inch. A gun in which the barrel moves only a short distance and the breech block moves through the rest of its travel from the momentum imparted to it by this motion of the barrel, is called a "short-recoil" gun.

There is another kind in which the barrel moves all the way to the rear along with the breech block and then leaves the breech block back in the rearward position while the barrel goes forward. This is called the "long-recoil" type.

Both of these will be described in turn, and as the simplest example of the short-recoil type of action we will take the Service automatic pistol shown in Fig. 5.

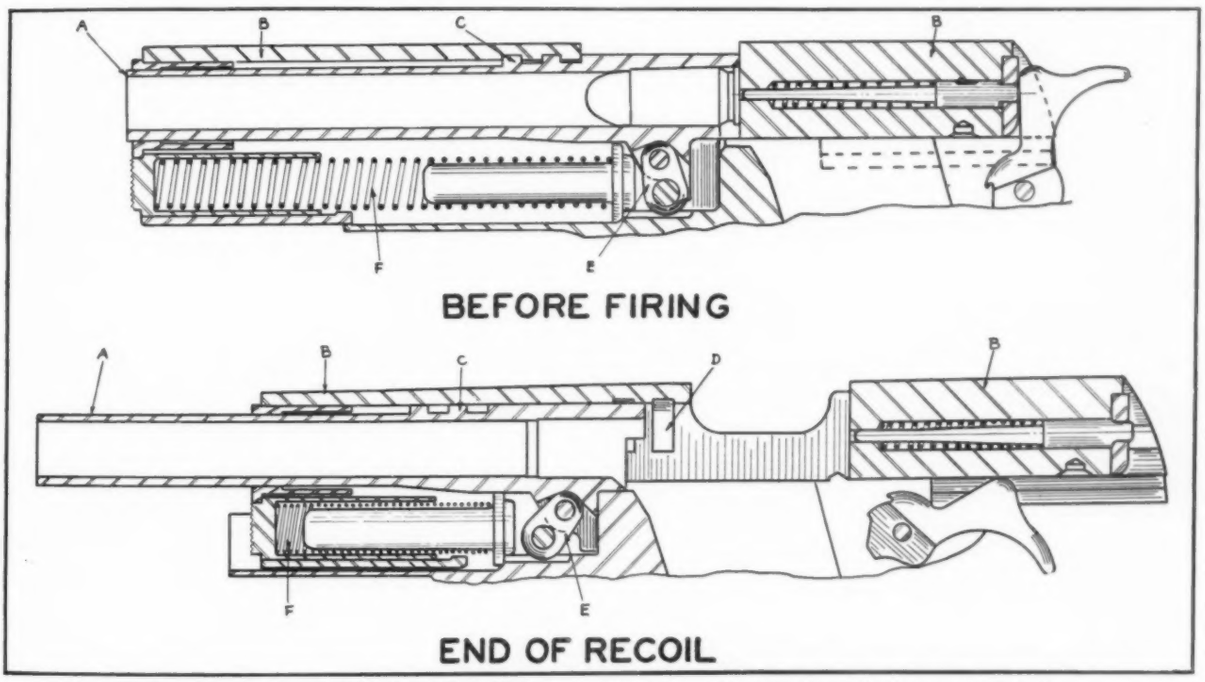


Fig. 5. Diagram of Short-Recoil Type Breech Closure Principle as Used in the Colt Automatic Pistol.
(For explanation see text, this page.)

COLT AUTOMATIC PISTOL: In this mechanism the barrel and breech are locked together, and when the gun is fired the recoil drives them both back at one time. However, it takes only about one-quarter of an inch of motion to unlock the breech block from the barrel and as soon as this one-quarter inch has been completed, the barrel strikes sharply against a stop and remains in position while the breech block continues on back through the inertia imparted to it by the one-quarter inch kick, coupled with a residual pressure that may remain in the case.

The detail action is as follows: (Refer to Fig. 5, below.)

Referring to the diagram marked "Before Firing," it will be observed that the barrel, *A*, is locked to the slide, *B* (which is in one piece with the breech block), by the locking shoulders, *C*, formed on top of the barrel and fitting into the recesses, *D*, in the slide. When the gun is fired the recoil pushes the slide and breech block, *B*, to the rear and as the slide is locked to the barrel, the barrel is also carried to the rear. However, the barrel is pivoted to the frame of the pistol by means of the link, *E*, and as the barrel continues its rearward motion, the top end of this link first moves backward in the arc of a circle and then downward around the lower pin as an axis. This motion swings the back end of the barrel downward, and disengages the locking shoulders in the slide, which continues to the rear, leaving the barrel in position with its bottom lug against the stop shoulder in the frame. This rearward motion of the slide throws out the empty cartridge and at the same time compresses the return spring, *F*, which immediately returns the slide to its forward position, at the same time feeding a new cartridge into the chamber from the magazine in the handle (not shown in the drawing). As the slide completes its forward motion, it strikes against the rear end of the barrel and as the barrel goes forward it swings upward through the action of the link, causing the locking shoulders, *C*, to engage in the recesses, *D*, in the slide.

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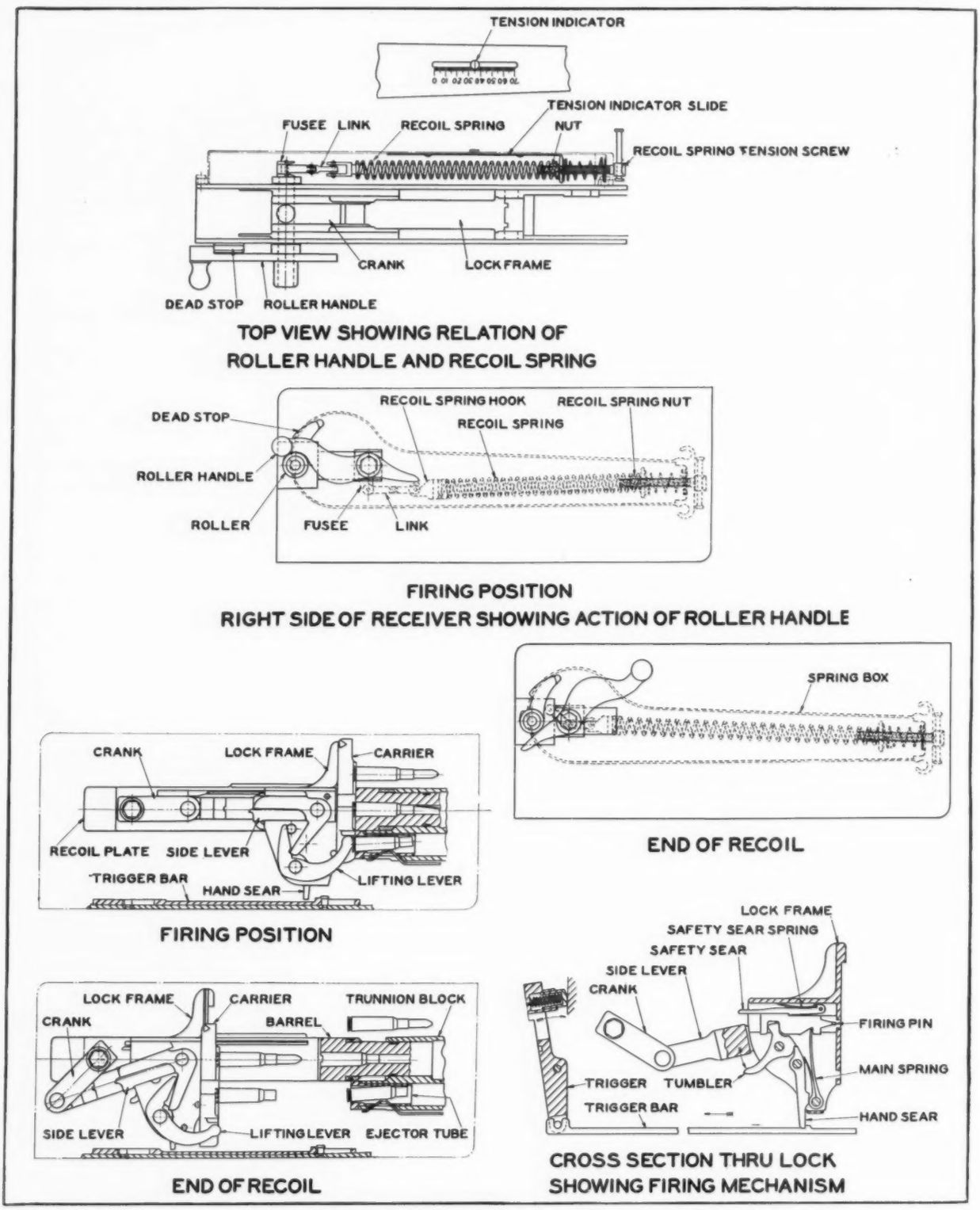

Fig. 6. Diagram of Short-Recoil Type Breech Closure Principle as Used in the Maxim Machine Gun.
(For explanation see text below and on opposite page.)

MAXIM AND BROWNING MACHINE GUNS: These two guns are also examples of the short-recoil type of mechanism, but in a much more refined form. As described above, in the Colt pistol the barrel goes back about one-quarter of an inch, carrying the breech block with it and stops with a bang against the solid shoulder and lets the breech block go on to the rear by its own momentum. This will work with a low-powered cartridge like that used in the pistol, but even so the shock to the action of the gun is severe, and with a high powered cartridge it is necessary to resort to some device by which the barrel is gradually brought to a stop through transferring its energy to the breech block and then allowing it to

be gradually absorbed through a fairly long travel of the breech block against the return spring.

In the Maxim machine gun (Fig. 6) the locking of the breech is accomplished by having the breech block (called in this gun the "lock") attached to the barrel extension (called in this gun the "recoil plates") through the medium of a crank and connecting rod (called in this gun the "side lever") as was discussed under the subject of retarded blow-back guns. However, in the Maxim gun the crank is on dead center when the explosion comes, so that the lock cannot move back in relation to the barrel, and the thrust of the cartridge on the lock is transmitted through the side lever and crank to the crank axle and thence to the recoil plates through which the crank axle passes. Hence the barrel, lock and recoil plates all move back together as a unit, under the force of the recoil.

On the right-hand end of the crank axle is a handle with a convex shaped bottom, and this handle rests on a roller attached to the side of the gun. As the barrel, lock and recoil plates move back together, this handle, which is on the axis of the crank, also moves back, while the roller is fixed in position on the side of the gun. An examination of the figure will readily show that this backward motion of the roller handle against the roller causes it to rotate so that the back end of the handle moves upward. This rotation of the crank axle by means of the roller handle throws the crank and connecting lever off dead center and draws the lock away from the barrel. In other words, as soon as the roller encounters the cam on the roller handle, the action of the cam is to slow down the barrel and transfer its motion into an accelerated rearward motion of the breech block. However, as the rotation of the roller handle continues, the tail of the roller handle strikes on the roller and by the action of these two surfaces on each other the rotation of the roller handle is checked and the recoil plates are pushed forward, shoving the barrel to battery.

On the left-hand side of the gun there is a strong spring attached to the extension on the end of the crank axle. This recoil spring tends to do two things; first, to keep the barrel pulled into battery and resist any rearward motion, and second, to keep the roller handle rotated so that the lock is in the closed position. As soon, therefore, as the barrel has been returned to battery by the reaction of the tail of the roller handle against the roller, assisted by the pull of the recoil spring, a further pull of the spring rotates the handle back into the original position, and closes the breech of the gun, putting the lock back in the firing position. This action can be very easily understood from the diagrams.

However, the drawing does not show the method of feeding the cartridges into the gun. They are supplied in a fabric belt and there is a feed crank operated by the recoil of the barrel which advances a fresh cartridge into position each time the barrel moves to the rear.

The Browning gun accomplishes the same thing in a somewhat different manner. In this gun the barrel moves to the rear about five-eighths of an inch. There is a frame screwed onto the back end of the barrel. This frame is called the barrel extension, and the heavy breech bolt is locked to this frame through the medium of a vertical sliding bolt, called the breech lock, which is actuated by a cam on the bottom of the gun. Thus when the barrel and barrel extension are in the forward position, the bolt is locked securely to the barrel extension. However, when the barrel recoils about one-half inch the breech lock cam is drawn down out of engagement with the bolt and the bolt is entirely free from the barrel and barrel extension. As the barrel continues its backward motion it strikes against the convex side of a curved lever, the point of which rests against the breech block. The continued motion of the barrel to the rear swings this lever backward in such a manner as to separate the breech block from the barrel; in other words, to slow up the barrel and speed up the breech

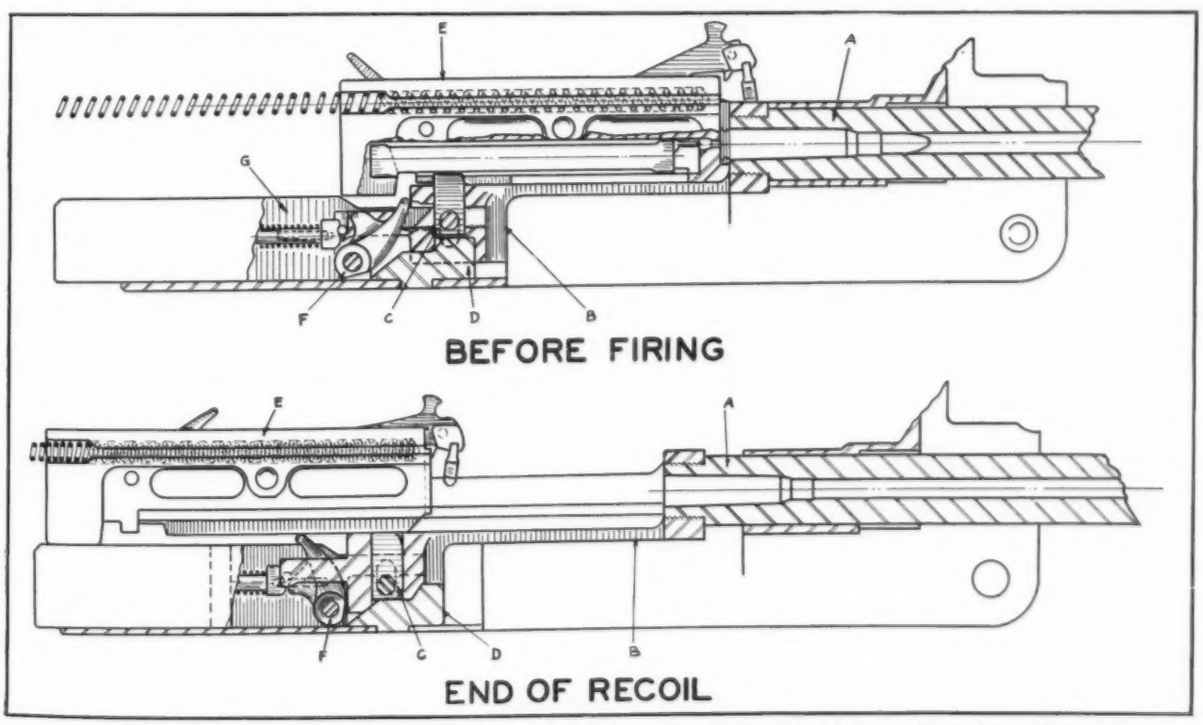

Fig. 7. Diagram of Short-Recoil Type Breech Closure Principle as Used in the Browning Machine Gun.
(For explanation see next page.)

block, throwing it forcibly from the barrel and at the same time extracting the cartridge case. Of course the breech block already had a rearward motion imparted to it while the barrel was recoiling, but this motion is increased or accelerated by the action of the curved lever which is accordingly called an accelerator.

The mechanism of this gun, which is shown in Fig. 7, will now be described in detail. The barrel, *A*, is screwed into the barrel extension, *B*, which extends to the rear for several inches and carries in a slot in its rear end the vertical sliding breech lock, *C*. In the closed position the breech lock cam, *D*, in the bottom of the gun, holds the breech lock up so that its top end engages in a slot in the bolt, *E*, and locks it to the barrel extension.

When the gun is fired, the barrel, *A*, recoils about five-eights of an inch carrying with it the barrel extension, *B*, the breech lock, *C*, and the breech bolt, *E*, all locked together. However, as the parts move to the rear the breech lock moves off the high surface on the breech lock cam and a transverse pin through the breech lock strikes a slanting surface on the lock frame, *G*, which forces the breech lock down out of engagement with the breech block.

Just under the breech bolt there is an accelerator, *F*, pivoted on a horizontal axis. As the barrel extension, *B*, moves to the rear it swings this accelerator backward and the point of the accelerator catches in a notch in the bolt and throws the bolt forcibly to the rear, compressing the return spring which immediately returns the bolt to its forward position.

While the bolt is in the rearward position, the barrel extension and lock frame are fastened together by the accelerator in such a position that the barrel cannot move forward. However, when the bolt goes forward far enough to strike the accelerator, it disengages the barrel extension from the lock frame and allows the barrel and barrel extension to move forward with the bolt as it completes its motion. The forward motion of the barrel extension carries along with it the breech lock which rides up the sloped surface of the breech lock cam and again locks the bolt to the extension ready for firing.

The backward motion of the bolt extracts the empty cartridge case and the forward motion feeds a new one in. The top of the bolt has a cam slot in it which actuates the lever which feeds the belt of cartridges in, the width of one cartridge each time the bolt moves to the rear.

Long-Recoil Type: The long-recoil type of automatic mechanism, in which the barrel and breech bolt, locked together, recoil for several inches, and then the breech bolt is held back while the barrel goes forward, is used for the Remington auto-loading rifle, the Remington, Winchester and Browning automatic shotguns, and the Chauchat machine rifle.

In a typical gun of this type there are two return springs, one to return the barrel and a separate one to return the breech block. The breech block being locked to the barrel when the cartridge is fired, the pressure on the head of the breech block drives it three or four inches to the rear until it is arrested by striking a stop provided for this purpose. The barrel being locked to the breech block, also goes to the rear and this rearward motion compresses both the breech block return spring and the barrel return spring. When the breech block has

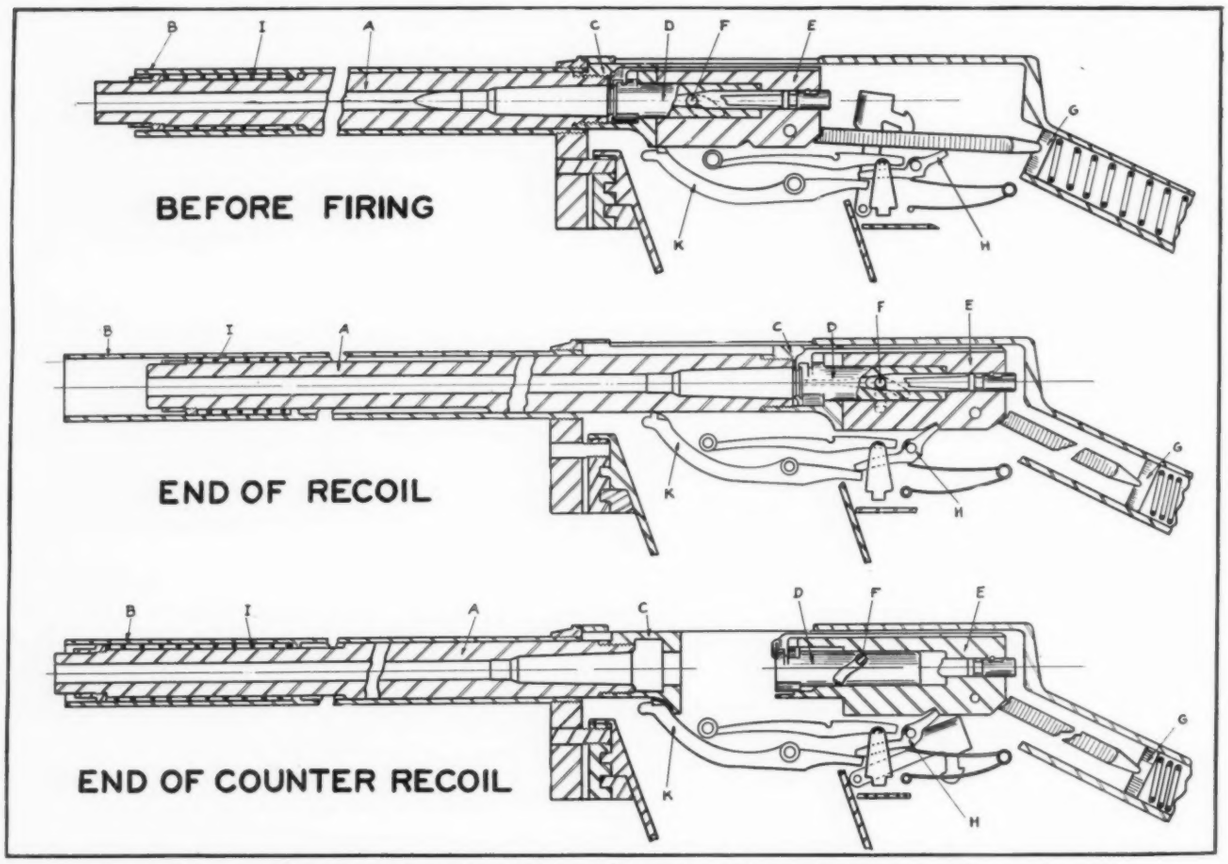

Fig. 8. Diagram of Long-Recoil Type Breech Closure Principle as Used in the Remington Autoloading Rifle.
(For explanation see text on opposite page.)

reached the limit of its rearward motion, it is caught and held in that position by a latch. The barrel return spring then pushes the barrel forward and the lock on the breech block is so constructed that when the breech block is held and the barrel is pulled forward, the bolt will unlock itself from the barrel and allow the barrel to go forward. As the barrel goes forward, the empty cartridge, held to the breech block by the extractor, is ejected. As the barrel reaches its forward position, it strikes a lever which drops the latch and allows the breech block to come forward, feeding in a new cartridge.

REMINGTON AUTO-LOADING RIFLE: The action of this type of breech closure can be followed in detail by reference to Fig. 8 showing the Remington auto-loading rifle. The barrel, *A*, is supported in a barrel jacket, *B*, and is held forward by the coil spring, *I*, surrounding the barrel. The breech block, *E*, has a turning bolt head, *D*, arranged to be rotated by the action of two pins, *F*, working in cam slots cut in the sides of the bolt head, *D*.

This bolt head is arranged to lock in the barrel extension, *D*, by the action of the pins, *F*, in the cam slots, turning the bolt head. There is a separate return spring, *G*, for holding the breech block in the forward position.

When the gun is fired the parts recoil into the extreme rearward position, as shown in the figure marked "End of Recoil." At this point the breech block is locked in its rearward position by the latch, *H*, and the barrel then starts forward under the impulse of the barrel return spring, *I*. As the barrel moves forward it draws with it the bolt head, *D*, but this forward motion of the bolt head causes the pins, *F*, to act in the cam slots so as to turn the bolt head and release it entirely from the barrel. As the barrel continues forward it leaves the empty cartridge case held by the extractor and when the barrel is entirely off the cartridge case a spring ejector in the bolt head kicks the cartridge out of the gun. At this moment the parts have reached the position marked "End of Counter-recoil" and the curved surface on the bottom of the barrel at the rear end strikes against the lever, *K*, which in turn disengages the latch, *H*, allowing the breech block to be pushed forward again by the spring, *G*. As the breech block goes forward it feeds a new cartridge into the barrel from the magazine (not shown). As the bolt approaches its forward position, the bolt head, *D*, enters the recess, *C*, in the barrel and then a further motion of the bolt causes the pins, *F*, to act on the cam slots in the bolt head in such a manner as to turn the bolt head and lock it to the barrel so that the gun is again ready for firing.

GAS-OPERATED TYPE: While the original machine gun was built on the recoil-operated principle and while nearly all automatic pistols are made on this principle, the gas-operated system has also been a great favorite, especially with inventors of semiautomatic shoulder rifles, as it does away with the necessity for mounting the barrel so that it can slide, which is a great complication in making a rifle.

One of the earliest successful machine guns, the Colt, invented by Mr. Browning in 1889, was gas-operated. The Hotchkiss gun, invented about the same time, was also gas-operated, and both of these guns have been used extensively ever since. During the World War the Colt gun was modified somewhat by the Marlin Arms Corporation, of New Haven, though the breech mechanism remained the same in principle as did the construction of most of the parts.

A light form of the Hotchkiss, known as the Bénét Mercié, was adopted as the standard of the U. S. Army in 1909 and remained standard until 1916. This also was a gas-operated gun.

Then at the beginning of the World War, Mr. Browning submitted a model of what he called a light machine gun built on the gas-operated principle. This gun, afterward known as the Browning Automatic Rifle, was adopted and many thousands of them were used during the World War. While it is called an automatic rifle, the reader should clearly distinguish between this type of automatic rifle which is really a light machine gun, and the semiautomatic rifle which is a self-loading shoulder rifle to take the place of the Springfield. Bear in mind that the "automatic rifle" and the "machine rifle" are really light machine guns.

While the recoil-operated principle as embodied in the Maxim, Vickers and Browning guns was more widely used than any other, the gas-operated type as exemplified in the Colt, the Hotchkiss and the Marlin machine guns and the Browning automatic rifle, has been a close second in popularity.

As mentioned above, the gas-operated system has been the favorite for semiautomatic shoulder rifles, but while a great many guns have been produced which operate on this principle, none of them has yet attained any lasting popularity or wide use. Among the more prominent ones may be mentioned the Mondragon, adopted by the Mexican Government in 1911 but never very extensively used; the "Standard" automatic shoulder rifle manufactured about 1915 by a company in Delaware for hunting purposes; and the St. Etienne semiautomatic shoulder rifle used to a limited extent by the French during the World War.

In the conventional gas-operated system there is a hole drilled in the barrel, and some of the gas of the explosion passes through this hole and acts on a piston lying underneath the barrel, driving it to the rear with sufficient force to unlock and open the breech. One of the great troubles with rifles of this kind has been the fact that it is difficult to control this gas under extremely high pressure so as to prevent it from operating too quickly. Recently an inventor, named White, submitted a gas-operated shoulder rifle in which the front end of the gas piston is hollow and the gas port is bored not only through the barrel and through the gas cylinder, but through the walls of this hollow piston so that as soon as the piston starts to move the gas port is cut off after the manner of the slide valve in a steam engine. Thus gas can go into the hollow piston only before it starts its motion; as soon as it begins to move the gas supply is shut off and the gas which is already in the piston is supposed to act by expansion, therefore producing a less violent action than would otherwise occur. So reasons the inventor. However, other designers state that inasmuch as the gas pressure in the barrel lasts only about a thousandth of a second, it makes no difference whether this cut-off action is used or not.

Another inventor who attempted to get away from the brusque action of the gas is Mr. Hudson, who invented a machine gun in which he uses the gas to compress the spring which then operates the mechanism.

THE most successful semiautomatic shoulder rifle yet tested by the Government is the new Garand, which is a gas-operated gun, though the gas is taken not through a port cut in the barrel, but between the end of the barrel and a cap screwed over the muzzle. This gun differs from most gas-operated guns in that the gas does not start to open the mechanism until after the bullet has left the barrel. Thus the violence of

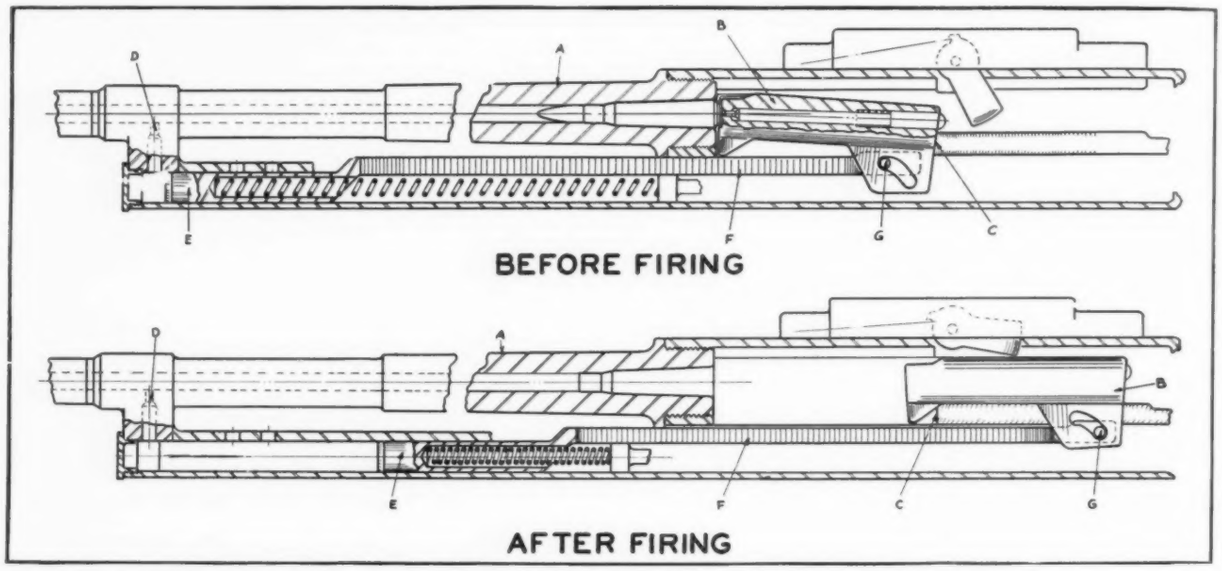

Fig. 9. Diagram of Gas-Operated Type Breech Closure Principle as Used in the Marlin Machine Gun.
(For explanation see text below.)

the action is greatly reduced, and moreover, the work of opening the bolt is easier because the pressure has by that time dropped almost to zero.

This new Garand rifle seems to be the fulfillment of about thirty years' effort on the part of the Army to make a semi-automatic shoulder rifle that would be as light as the Springfield and at the same time as simple and rugged in all its parts. This rifle has been tentatively adopted by an Army testing board and a limited number are now being constructed at Springfield Armory for extended service test by the Army.

In order to give the reader an opportunity to study the mechanical action of the gas-operated breech closure in detail, three different examples of this type of mechanism will be illustrated with drawings and descriptions. The guns chosen for illustrations are the modified Colt, known as the Marlin, the Browning automatic rifle and the Garand semiautomatic rifle.

Marlin Machine Gun: The mechanism of the Marlin machine gun, shown in Fig. 9, operates as follows: The barrel, *A*, has a gas port, *D*, drilled in it at some distance from the muzzle. This gas port communicates with a gas cylinder lying under the barrel containing a piston held in its forward position by a spring. This piston is attached to the bolt, *B*, through a connecting rod, *F*, which is fastened to a pin, *G*, riding in a cam slot in a wing on the bottom of the bolt. When the piston is forward the bolt is forward and the rear end of the bolt is drawn down by the action of the pin, *G*, in the cam slot, until the back surface of the bolt rests against the locking shoulder, *C*, cut in the receiver. When the gun is fired the cartridge is held firmly in place by the bolt, which is locked in position against the shoulder, *C*. After the bullet passes the gas port, *D*, near the muzzle of the barrel, some of the gas rushes into the gas cylinder and impinges on the head of the piston, *D*, driving it violently to the rear, together with its connecting rod, *F*, and the pin, *G*, which is in the slot in the bolt. As the pin, *G*, goes to the rear, the first action is to press on the top of the cam slot and raise the bolt up out of engagement with the shoulder, *C*, after

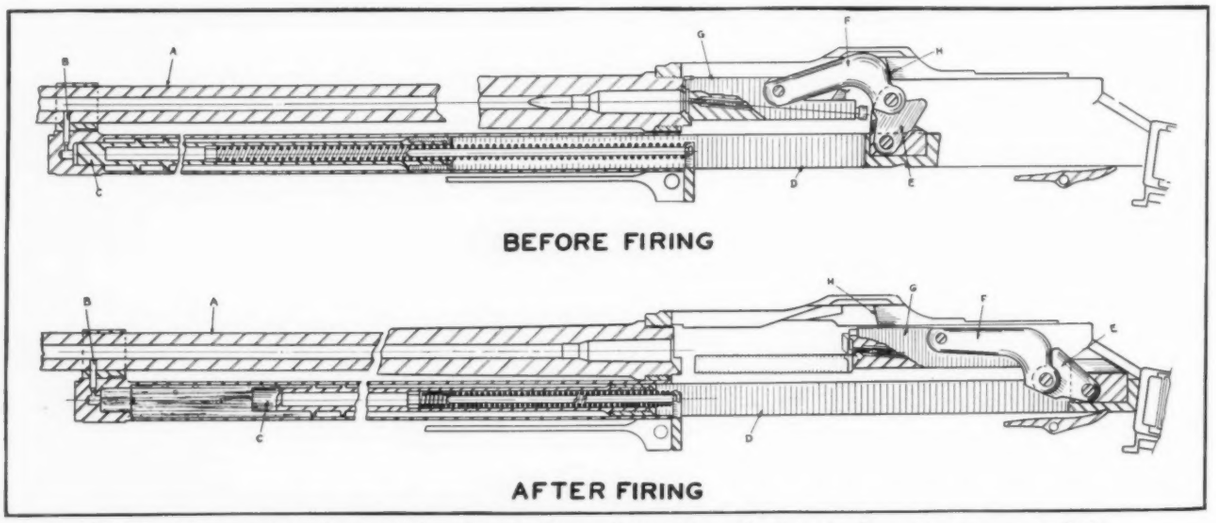

Fig. 10. Diagram of Gas-Operated Type Breech Closure Principle as Used in the Browning Automatic Rifle.
(For explanation see text, page 345.)

which the bolt is carried to the rear as shown in the cut marked "After Firing." This rearward motion of the bolt ejects the empty cartridge. The compressed return spring immediately causes the piston to move forward, carrying the bolt with it, until the shoulder, *C*, is reached, when the action of the pin, *G*, in the cam slot again locks the bolt down behind this shoulder and the gun is ready for firing once more.

BROWNING AUTOMATIC RIFLE: The operation of the Browning automatic rifle is shown in Fig. 10. In this gun the barrel, *A*, has a gas port, *B*, and there is a piston, *C*, lying in the gas cylinder under the barrel. This piston connects with the bolt, *G*, by means of the connecting rod, *D*. However, instead of being connected to the bolt by means of a pin in a cam slot, the connection in this case is by means of a linkage consisting of the bolt link, *E*, and the bolt lock, *F*. In the firing position the bolt lock, *F*, presses against the shoulder, *H*, in the top of the receiver and this holds the bolt firmly in position against the head of the cartridge. When the gas impinges on the end of the piston, *C*, and drives it to the rear, the bolt link, *E*, draws the bolt lock down out of engagement with the shoulder, *H*, and then draws the bolt to the rear, as shown in the cut, "After Firing."

GARAND SEMIAUTOMATIC RIFLE: The principle of the Garand semiautomatic rifle is shown in Fig. 11. It is of the gas-operated type, but instead of having a gas port in the barrel, it has a muzzle cap, *B*, screwed onto the end of the barrel. After the bullet has passed out of the barrel, *A*, some gas goes down between this muzzle cap and the barrel and strikes on the piston, *C*, driving it to the rear, together with its connecting rod, *D*, which works the bolt through a cam slot and a lug, *E*. The bolt is of the common rotating type locked to the rear of the barrel by locking lugs engaging in suitable recesses. As the piston goes back, the cam slot working on the lug, *E*, first rotates the bolt, then carries it to the rear. As soon as the rearward motion is completed the return spring pushes the piston forward, closing the bolt and rotating it into the locked position. This gun has a great advantage over most gas operated rifles in that the gas does not start to operate on the piston until the bullet has left the barrel entirely.

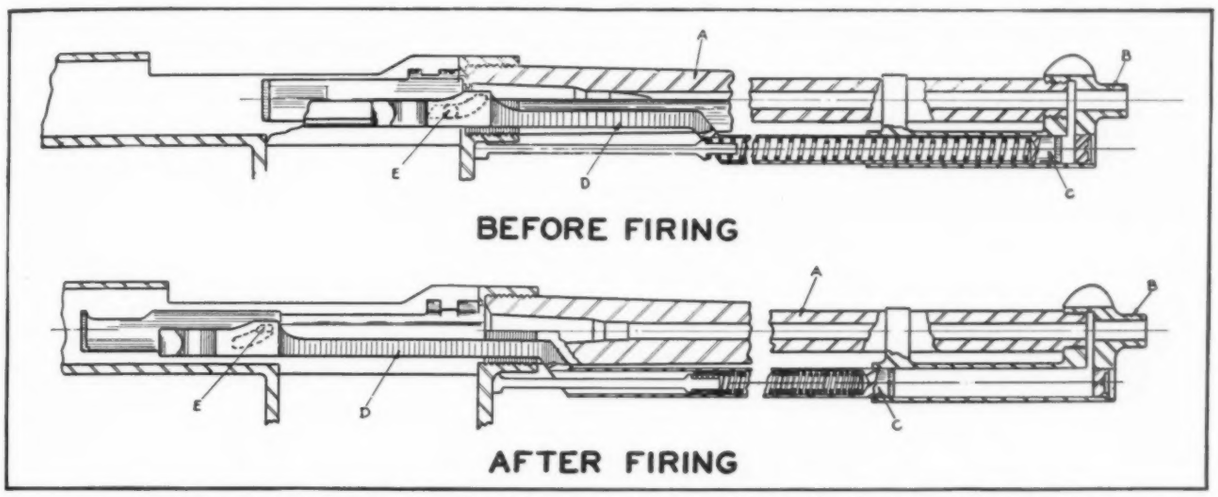

Fig. 11. Diagram of Gas-Operated Type Breech Closure Principle as Used in the Garand Semiautomatic Rifle.
(For explanation see text below.)

BANG PRINCIPLE: In 1911 Soren H. Bang, of the Danish Recoil Rifle Syndicate, presented a semiautomatic shoulder rifle to the United States Government for test, and this rifle functioned exceptionally well. The principle on which it operated is shown in Fig. 12.

The barrel had a sliding cap, *A*, fitting over the muzzle. When the bullet passed out, some of the gas acting in the space between this cap and the end of the barrel, pulled the cap forward as shown in the figure marked "After Firing."

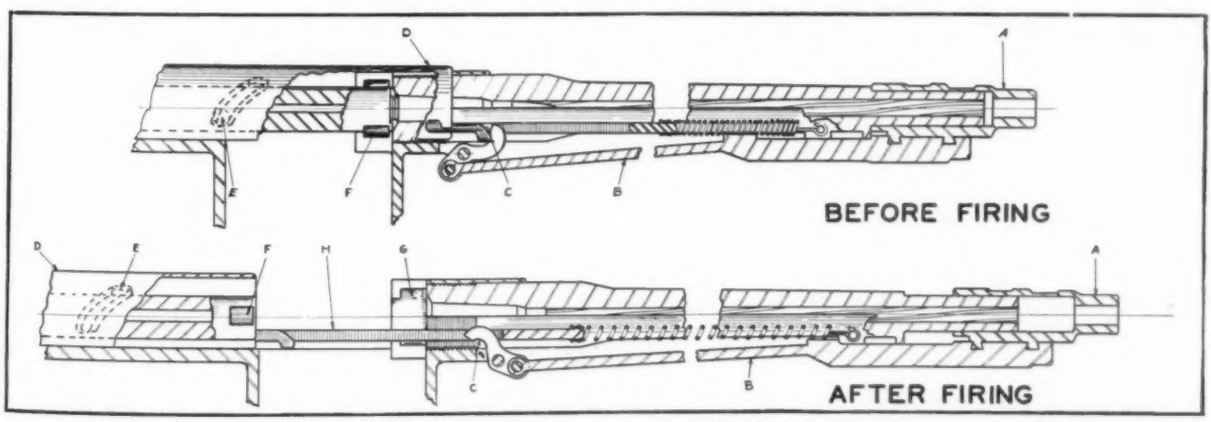

Fig. 12. Diagram of the Bang Breech Closure Principle as Used in the Bang Semiautomatic Rifle.
(For explanation see text above.)

The cap, *A*, was fastened to a connecting rod, *B*, which operated a lever, *C*. This lever in turn acted against a sliding breech cover, *D*, having in it a cam cut acting with a lug, *E*, on the bolt. In the position of rest, the bolt is locked to the barrel by the locking lugs, *F*, in the locking recess, *G*. When the gun is fired the gas escaping from the muzzle pulls the muzzle piece, *A*, forward, thus causing the lever, *C*, to throw the sliding breech cover, *D*, quickly to the rear. As this cover goes to the rear, the cam slot acting on the lug, *E*, turns the bolt so as to unlock it and then carries the bolt to the rear along with the breech cover. There is a return spring under the barrel which is connected to the breech cover through a rod, *H*. As soon as the rearward motion is arrested, the spring pulls the breech cover forward again and when the forward motion of the bolt is completed the cam slot in the cover acting on the lug, *E*, again locks the bolt to the rear end of the barrel.

PRIMER ACTUATED TYPE: Among the many novel ideas for operating a semiautomatic rifle, is the scheme for allowing the primer to move enough in the cartridge case to unlock the breech mechanism. If the head of the cartridge were held around the edge only, leaving the primer free, the primer

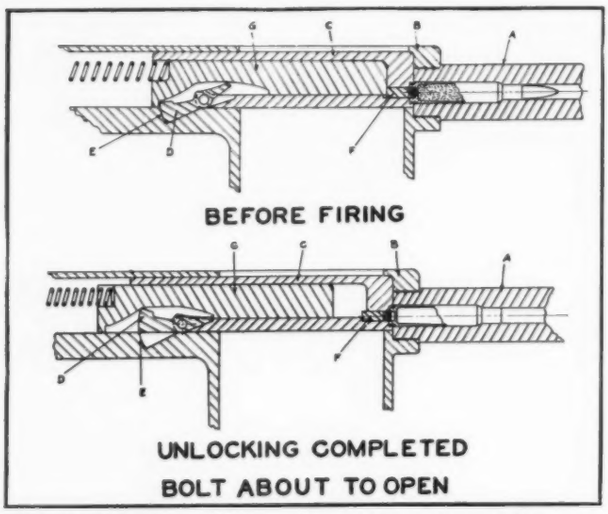

Fig. 13. Diagram of Primer-Actuated Type Breech Closure Principle as Used in the Garand Semiautomatic Rifle.
(For explanation see text, this page.)

would move back under the pressure of the gas when the gun is fired, and if it were allowed enough freedom it would be blown entirely out of the cartridge case. However, it is possible to control this motion and allow the primer to move back just a few hundredths of an inch, utilizing this short but powerful motion to impart energy enough to the moving actuator to cause it to unlock the breech.

Mr. John C. Garand, of Springfield Armory, built a semiautomatic rifle operated on this principle which showed a considerable amount of promise in tests. In fact, a number of these rifles operated very successfully with the standard ammunition in use at that time, but it was found that this mechanism did not have sufficient flexibility to make it work the same with different types of powder, so it was finally dropped in favor of the later Garand gas-operated rifle. In spite of the fact that this rifle is not now being used, a description of the mechanism is included here because the novelty of this principle makes it interesting to any student of firearms.

Referring to Fig. 13, *A* is the barrel screwed onto the receiver, *B*. *C* is the breech block containing inside of it a moving actuator, *G*, arranged to have motion imparted to it by a slight motion of the firing pin, *F*. When the gun is fired the firing pin moves back about three-hundredths of an inch. This motion is very quick and imparts a considerable blow to the actuator, *G*, which travels rapidly to the rear.

The bolt up to this time has been locked to the receiver, by the locking block, *D*, bearing on the shoulder, *E*. As the actuator goes to the rear the cam surface lifts this locking block out of engagement with the receiver and the bolt then moves to the rear with the actuator against the action of the return spring, which causes the parts to move forward again as soon as the rearward motion is completed.

CALIBER .22 MACHINE GUN: While most of the principal methods of operating machine guns and semiautomatic rifles have been described above, one can never be sure when an inventor will come in with something entirely new and different. For example, a short time ago a desire was expressed by the Army for some means of shooting caliber .22 cartridges in a machine gun. It was desired to do this for two reasons; first, because it was thought that by using the very cheap and inexpensive caliber .22 cartridges for machine gun practice in time of peace, a great deal of training could be obtained without expending the expensive full powered cartridges and, consequently, much money would be saved; and in addition, it was desired to find some safe method of allowing troops to obtain antiaircraft practice with machine guns, which in most military posts cannot be accomplished with full powered cartridges because the great power and range of the Army cartridge makes it dangerous to fire at high elevation.

At first glance it seemed very difficult to construct a machine gun that would work with the low powered caliber .22 cartridge, but a young mechanic, David M. Williams, of Godwin, North Carolina, appeared in the Ordnance Office and offered, not to make a special machine gun for .22's, but to take a heavy Browning gun and operate its massive mechanism with the .22 cartridge. This feat appeared so absolutely impossible that the arms experts had not even given it any consideration, but when this young inventor outlined his proposed method of doing the job he was given the order to proceed. In six weeks he modified a Browning machine gun so that it operated in a normal manner with the caliber .22 cartridges with never a malfunction. The Browning gun is a recoil-operated gun and the caliber .22 cartridge does not have a fraction of the recoil power to operate this gun, but Mr. Williams accomplished his job by making the chamber of the gun in a separate piece from the barrel, somewhat in the same way as the cylinder of the revolver is separate from the barrel. The separate chamber, however, instead of being outside the barrel was in the form of a hollow piston fitting into the rear end of the barrel. When the gun is fired the gas of the explosion gets into the space between the face of the cylinder and the rear end of the barrel, and the pressure of the gas is sufficient to force the separate chamber backward with more than enough recoil to operate almost any mechanism. (*This concludes Major Hatcher's article. Part I was published in the preceding issue of this Journal, Vol. XIII, No. 77.*)

The Index to ARMY ORDNANCE, Volume XIII, which concludes with this number, is now in preparation. It is arranged by subject and author alphabetically and includes title page for binding. Copies of the Index will be furnished without cost upon application to the Editorial Office.

The Guns Must Travel Fast

Speed and Dependability the Need of Motorized Artillery

By Joseph M. Colby*

AT the close of the World War a board of officers under the chairmanship of Brig. Gen. W. I. Westervelt, U. S. Army, was appointed to study, among other subjects, "The Methods of Transport of the Artillery to be Assigned to a Field Army." These officers, after a thorough study of the equipment of the leading foreign armies and with their minds fresh with the experience of war, were in a position to give unusually valuable advice in the mechanization of our army. The importance they ascribe to the problem of transportation is seen from the following extract from their report:

Roads Like This May be Expected at the Front—Wheeled Vehicles Would be Helpless Here.

"In the completest conception of an offensive, the machine starts from rest. It is at this time that the offensive mass is at its maximum. The preliminaries in an offensive combat are designed to break down the physical and moral resistance of the enemy, the opposing friction, so to speak, and to make subsequent progress as economical as possible and as rapid as desirable. Motion, or velocity of offensive progress, commences when the enemy's organized resistance begins to yield. It is at this time that the energy—that is, the mass and the movement of the offensive—expresses itself in progress toward the desired goal, namely, the break through.

"In the second phase, we find the machine in motion. It is now that the varying rates of speed of the different combat agencies begin to impress us most particularly. It is now that the time element, more or less inconspicuous in the first phase, begins to be a dominating one. *It is now that transportation—supplies, ammunition, guns, etc.—has to move.* Infantry will certainly move; across country, it is the most mobile combat agency. Velocity there will certainly be in abundance as the lighter lines progress into the enemy's country, but *mass and, therefore, energy will be lacking unless artillery and supplies keep up.* An advance goes well enough in the area covered by artillery fire. Beyond the action of artillery, however, the enemy is unhampered in his defensive and counter-offensive dispositions. The mass of the enemy's resistance increases to a point where it is not possible to penetrate it with a rapidly diminishing offensive mass, no matter how high the velocity of the latter may be. *The offensive lacks energy due to the absence of those agencies which made the original advance possible;* exhaustion exacts its penalty."

At the time the Caliber Board submitted this report, the automotive field was emerging from its infancy, hence many of the Board's recommendations were prophetic in nature. Phrases such as, "at the present state of development," "we can conceive," and "the next and ultimate step," frequently catch the eye, but we must remember that these are recommendations for the equipment of an army of the future, and, rightly, they were made subject to future development and test.

While studying the equipment of contemporary armies of the World War, the Board made the following interesting observations. It was noted that the German, Italian and British armies "confined themselves, for the most part, to wheeled vehicles, which type at once limits mechanical artillery transport almost entirely to good roads." "The French finally recognized during 1917 the necessity and advantage of cross-country mechanical transport as evidenced by their development" of several types of tracklaying vehicles. The advantage of the tracklayer "makes the caterpillar the only logical prime mover to replace the team in draft."

In general the experiences of the Punitive Expedition into Mexico, and of the World War, showed that wheeled vehicles had neither the flotation nor the traction for off-the-road work, hence the transportation limitations of the various automotive types are generally stated as follows:

a. "The rear-wheel drive truck and high speed motor truck can be operated on good roads."

b. "The four-wheel drive truck and light motor car can be operated on almost all classes of roads."

c. "The caterpillar can be operated on all classes of roads and also in open country."

Since the "energy of the offensive" is dependent mainly on divisional transport, and since tactical movement in a division is chiefly across country through the combat area, this classification almost at once limits the divisional prime mover, or cargo carrier, to the tracklaying type.

After a lapse of 12 years, since the Caliber Board submitted its recommendations, it is interesting to review the field of development to see how closely its trend has followed the vision of the board.

Our defense system, the nature of which allows only a very small army and a very limited reserve of matériel, places much dependence on the ability of our commercial industries to turn out supplies quickly in case of war. Since these sup-

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A Track-laying Vehicle Can Take Advantage of Shell Holes for Protection.

plies, at the outbreak of war, must be obtained without delay of manufacturing new jigs and fixtures, it is thought preferable to use a standard commercial product, rather than develop special jobs, even though the former may be slightly inferior in performance. Frequently, however, the army does do development work on various machines to bring them to the perfection of performance which will create a demand for the machine on the open market and thus enable commercial concerns to set up manufacturing machinery. (Outstanding examples of this include the development of the airplane and the 4-wheel drive truck.) Hence, two guiding factors in development work have been:

a. The use of standard commercial product if it is at all adaptable for the purpose intended.

b. If no commercial product exists, the development of one which will create demand for commercial manufacture.

In carrying out the recommendations of the Caliber Board for the development of cross-country vehicles, a great many standard commercial tractors employing the tracklaying principles, or with crawler adapters, were tested. Many of these performed excellently at low speeds. Caterpillar tractors of the 2½-ton, 5-ton and 10-ton sizes were adopted as standard. They did not, however, fulfill the needs of the service because they were too slow attaining about 4½ miles per hour where 12 miles per hour at least was desired. Attempts to speed up the commercial tractor failed, so a special cargo-carrying job (Cargo Carrier T1), with a maximum speed of 18 m. p. h., was built using a new tank chassis and power train. While the performance of this vehicle was spectacular, certain mechanical features made it undesirable for general use. These were:

a. Semi-rigid suspension system did not provide satisfactory riding qualities.

b. Tracks, track pins and track rollers were subject to greater wear and required frequent replacement.

c. The clutch brake type of steering, which was satisfactory at low speeds, created forces counteracting inertia which had a devastating effect on the entire power train and suspension system.

d. In order to obtain speed, an unreasonably large power plant had to be installed to overcome track friction and shock forces of the steering system.

e. A truck or trailer carrier had to be provided to transport the vehicle over long hauls.

It should be noted here that the rejection of Cargo Carrier T1 was due to mechanical failure, not to unsatisfactory performance. Over muddy, soft, sandy, or hilly terrain it functioned in excellent manner. The test of this vehicle showed that much mechanical development work was necessary, however, before it could be considered sufficiently reliable for military use.

Attention was then turned to the large field of excellent commercial trucks which were being produced, the development of high speed tracklaying vehicles being left with the design of tanks. The motorization of one battery of 75-mm. guns in this manner was the first great departure from the recommendations of the Caliber Board. The placing of pneumatic tires on divisional artillery, enabling them to be towed over the highways at speeds in excess of 40 m. p. h., had high appeal.

The truck, while performing excellently over good or fair road conditions, has fallen down in all cross-country tests due chiefly to the fact that it has neither traction nor flotation sufficient for movement over normal soft terrain. This can readily be understood when it is known that unit ground pressures of a truck run as high as 30 lbs/sq. in. while those of a tracklaying vehicle are frequently less than 5 lbs/sq. in. or comparable to the pressure exerted on the ground by the foot of a normal size man. A report dated August 31, 1932, by the Field Artillery Board, covering the test of a 3-ton, 4-wheel drive truck, which is described as having "given an outstanding performance for a wheeled vehicle," and which was considered as "the best truck of this capacity which has been tested by them," stated, that on a slight upgrade of loose white sand and towing the 155-mm. howitzer M1918, "it required 30 minutes to traverse a stretch of 95 yards," and that they believed "it would have considerable difficulty towing the howitzer in mud and probably in snow." Snow or mud were not available for their test. It is also interesting to note that this board concludes that "it (the truck) lacks a certainty of operation under all conditions considered necessary in the prime mover to be used for tactical movements of a divisional howitzer, which certainty of operation is given by the standard artillery tractor," a tracklaying vehicle. Tests at the Aberdeen Proving Ground have shown that wheeled vehicles, whether 2, 4, or 6-wheel drive, are helpless in mud, sand, and on snow and ice without the aid of traction devices.

Only a Track-laying Vehicle Could Get Out of This.

This apparent need of increased flotation and traction brought about the development of several new traction devices, two of which merit consideration. The Hipkins Device consists of a series of grousered plates which are held to the driving wheel by a chain passing around the wheel between the dual tires. The half track is a chain-like track passing around both rear wheels of the rear 4-wheel bogie of a 6-wheel truck. The Hipkins Device secures flotation by the use of large plates, and traction by means of grousers. It is apparent that these characteristics seriously limit the speed of the vehicle. The shoes of the half track car can be made of short pitch and with continuous road bearing surfaces, so as to eliminate the undesirable features of the Hipkins Device, but here another serious feature enters the picture. It is seen that the front wheel in the track travels on the radius of the wheel plus the thickness of the track, but since the rear wheel rides on the track as though it were a plank, it turns on the radius of that wheel alone. Assuming a track of only ½-inch thickness the front wheels will then attempt to travel approximately 3 inches farther for each revolution than the rear wheels. This results in a drain of power and in an unreasonable wear on the tires, due to the wheels fighting each other. On rear 4-wheel drive trucks additional power losses and wear are due to the gear fight.

Commercial Trucks are Not Designed for Rigorous Cross-Country Work.

Traction devices are very effective over difficult terrain and it is believed that all wheeled vehicles should be equipped with one or the other for use in the case of emergency, but they do not convert trucks into efficient high-speed cross-country vehicles. In the first place, unit ground pressures are not reduced sufficiently to compare favorably with those of tracklaying vehicles—unit pressure reactions of the front wheels are not changed at all. Wheeled vehicles with either device cannot go over certain types of terrain on which tracklayers proceed with ease. Further, our commercial trucks upon which we must depend are designed for use on improved roads to meet the demands of a competitive market. Their factor of safety is not sufficiently high for cross-country work; their suspension systems are not flexible enough to traverse rough terrain; they have no obstacle crossing ability; their turning radii are large. Briefly, commercial trucks are not made for cross-country work.

It is not the intention of this article to condemn the wide field of excellent commercial trucks for military use, but, rather, to define their field of activity on the basis of results as obtained by proof test. They are well suited for the transport of supplies to the divisional dumps, or for the movement of corps or army artillery behind the combat areas. This field alone should place the output of commercial truck concerns at their limit in time of war.

Recently the Ordnance Department developed the Centaur—neither truck nor tractor, but half of each. Half Track Car T1, a greatly improved version of the French Citroën, is capable of speeds of 42 miles per hour over improved roads, 25 miles per hour over level cross-country covered with 8 inches of snow, speeds over rough terrain greatly in excess of those of wheeled vehicles, and is capable of traversing mud, sand, and steep slopes, where all other vehicles of the wheeled type, including a light truck with Hipkins Device, have been stuck. It is light, weighing 6300 lbs., and is made up of standard commercial parts with the exception of the half track unit which is simple in design and can be made without the creation of new manufacturing jigs and tools. This vehicle is suitable as a prime mover for the pneumatic tired 75-mm. gun or as a carrier for machine gun, trench mortar or Chemical Warfare squads. It would be an excellent substitute for the escort wagon. In general it is the best transport vehicle for the division that the writer has seen to date.

But this is a compromise vehicle—neither truck nor tractor; it does not have all the desirable features of a tracklaying vehicle and it still retains many objectional features of the truck. It has practically no obstacle-crossing ability; the suspension of the front wheels, being of commercial truck design, are not adapted for cross-country work; the front wheels will mire in soft ground. Hence this car is not the ideal for divisional transport either.

All tests to date show that the full tracklayer is the only automotive vehicle which can satisfactorily fulfill the performance requirements of the division. The several undesirable mechanical features, which caused suspension of the test of Cargo Carrier T1, have, with the advance of tank design, been greatly improved, or entirely eliminated, i.e.—

a. The individually sprung wheel provides such a flexible suspension that almost unbelievable speeds can be maintained with ease and comfort over cross-country terrain. The use of the air strut now permits the passengers to "ride on air."

b. Track pin and bushing wear has been eliminated by the rubber bushing. One rubber jointed track tested at the proving ground was run to destruction of the metal parts, but the rubber joint remained as good as new. Another tested on a tractor was run 1400 miles without any apparent wear.

Twenty-five Miles an Hour Across a Soft Swamp.

The Driver of this Cross-Country Car has gone for a Tracklaying Vehicle!

c. The substitution of the controlled differential type of steering for the clutch brake type not only eliminates the devastating effects of inertia which were due to clutch brake reactions on the power train and suspension system but greatly improves the ease of control and actually results in a material saving of power.

d. The use of rubber jointed tracks and the controlled differential type of steering greatly reduces the power losses inherent in the old type tracklaying vehicles. Further, the commercial market is now offering an excellent group of low priced, light engines which develop high horse power ratings, so the power plant today offers no unusually difficult problem.

e. The success of the convertible principle, as applied to tanks, eliminates the need of carrier trucks or trailers for strategic mobility. Tracklaying vehicles can be designed to run at high speeds over improved roads but the relative efficiency of wheels over tracks for this type of work makes the convertible vehicle preferable.

With the mechanical difficulties, which condemned Cargo Carrier T1 solved, the only consideration which might cause hesitation in adopting the high speed tracklayer for divisional work is the problem of procurement. Would this vehicle be a special army job and therefore not available through commercial manufacture in large numbers at the outbreak of a war? At the present writing the answer is "Yes," but with a little encouragement from the Army, commercial concerns are ready to install manufacturing facilities to make this type vehicle a standard commercial product. The reason for this, of course, is an increasing demand for the high speed crawler type from their sales field. The contractor wants good flotation, low speed and high torque for pulling dump carts through soft muddy excavations and high speed with low torque for towing these carts to dump grounds. The farmer wants low speed—high torque for plowing but can use high speed—low torque for harrowing and seeding and for transporting his products to the market. The road commissioner wants low speed—high torque for grading and repair, but high speed—low torque for maintenance. The commercial field is ready for the high speed tracklaying vehicle.

With this in mind and after tests of all available prime movers and cargo carriers, including 2, 4 and 6-wheel drive wheeled types, and half track cars, we return to the "ideal" for divisional work, as listed by the Caliber Board, the tracklaying vehicle. This is now mechanically reliable at high speeds and is ready for commercial manufacture so there is no reason to hesitate longer in bringing the high speed tracklayer to the division.

Summarizing: Tactical success is dependent on the success of divisional transportation.

Transportation in the divisional area, during the offensive, is wholly cross-country or over destroyed roads.

The only type vehicle giving satisfactory and reliable performance over cross-country terrain is the tracklayer.

The tracklayer has been developed to be mechanically reliable at high speeds.

Commercial concerns are now ready to make the high speed tracklaying vehicle a standard commercial product.

The high speed tracklaying vehicle is now ready for tests leading to its adoption as standard for divisional transport.

A Dangerous Area for a Wheeled Vehicle.

Medieval and Early Modern Cycle of War

In Which Limited Conflict Gave Way to the Absolute

By Hoffman Nickerson*

BEGINNING with the breakdown of the imperial Roman limitation of war by means of a professional army and the deliberate disarmament of the masses, the medieval and early modern cycle begins with a very different limitation by means of Catholic feudalism. This arrangement in its turn breaks down in the religious wars of the sixteenth and early seventeenth centuries, culminating in the Thirty Years War. There follows a new limitation which we may call that of the eighteenth century.

In the year 632 A. D., as a certain former camel driver named Mohammed lay dying in an obscure Arabian town, the Roman world was still intact. Its population, arts, culture and energy had indeed declined, but—with the doubtful and partial exception of Britain—its civilization and social habit were everywhere still Roman, most of it was still directly administered by the Emperor at Constantinople, and all of it was united by the omnipresent Catholic Church which had become its chief institution. Both the Emperor and the new local rulers in the west relied upon professional armies, and everywhere the masses, having now been systematically disarmed for nearly seven centuries, had become completely unwarlike. Within a single long lifetime the fanatical Moslems had overrun Syria, Egypt, North Africa and Spain, had twice besieged Constantinople and were preparing to attack what is today central France. When at last their armies were repulsed and they were no longer able to advance their borders, they remained none the less hostile, merely turning from conquest to plunder. Presently they were joined by another and even worse sort of raiders, the heathen Vikings from Scandinavia—apparently enough civilization had at last reached the distant north to permit the building of seagoing boats. The skillfully handled Viking ships entered every harbor and ascended every navigable river. Moreover the Vikings understood the importance of mobility and surprise: whenever they left their boats they began by rounding up horses from the countryside. They were horribly cruel, killing and torturing for pleasure, hating the weakened Roman world and especially the Catholic Church. The Christians despised them as much as they hated them, but in that improverished time with its bad communications the professional army system inherited from Augustus eight centuries before could no longer protect the West. So sheep-like had the mass of men become that we read of tiny Viking bands pillaging populous districts almost unopposed until the tardy arrival of troops. Mere thieves though they were, it seemed as if they would sting the debased Roman society to death.

Just in time, a remedy was found by reorganizing all Christendom for local defense. The decisive phase of the change seems to have come in the ninth century between the years 800 and 900. Unlike the imperial system of Augustus, the new arrangements were not deliberately planned; they arose more or less uniformly everywhere as makeshifts to fit the universal need of the rude time. At the base of society every free man must arm himself at his own expense; there must be no more unarmed countrysides to tempt heathen pillagers. The ancient universal liability for service, which had never disappeared from legal theory, was again enforced. Society was knit together by the arrangement known as feudalism. All government offices became hereditary possessions; in every village the local rich man was recognized as almost a little king. Every free man became the "vassal" of his local lord, swearing to defend the lord and his lands if attacked, and receiving the promise of protection in return. In the same way the local lord took a similar oath to a greater over-lord and the over-lord to a king. After a dim fashion, kings were supposed to depend upon the Emperor.

The head and heart of the new system was a fighting aristocracy. The remaining wealth of the age, insofar as it was not in the hands of the church, was held chiefly by a landed class, whose predecessors had been the landed magnates of the high imperial time. The men of this class now turned soldiers. Much of their incomes, derived from the rents of their free tenants and from the dues of their serfs, they spent on households of armed men. They fortified their country houses; just as our word village is derived from the Roman villa, so our word castle is the Latin *castellum*—a little fort. They themselves spent much of their time in practicing with weapons. Over and above the obligations of religion, the code by which they lived was that of military honor.

The medieval gentleman preferred to fight on horseback; as the old Greek word *hoplite,* originally "an armed man," had come to mean an armored infantryman, so in the early Middle Ages the Latin word *miles,* a soldier, was translated into the new local languages as knight, cavalier, chevalier, or caballero, meaning a cavalryman and particularly an armored cavalryman who was now the soldier par excellence. Chivalry was conduct becoming a mounted warrior. Each knight had at least two armed attendants, a "squire" to help him on and off with his armor and a "groom" to care for the horses. In an offensive action the fully armored knights were expected to do most of the work by mounted charges, thus continuing the tactical tradition of the armies of the later Roman Empire. On the defensive the knights would dismount and form the front rank, with the poorer freemen, unable to afford full armor or a horse, drawn up in a dense mass behind them. The men of a few poverty stricken districts like Ireland or Scotland fought on foot, and elsewhere the larger cities had steady militias capable of a solid defensive, but the armored cavalryman was the typical soldier.

The feudal horsemen broke the Saracen raiders. They turned back the great Viking harry, the worst peril our civilization has ever known, convincing those sea thieves who wished to remain in Christian lands that it was better to accept

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baptism and be digested into the body of Christendom. Shortly after the crisis of the Viking raids, reorganized Christendom repulsed a third attack, that of the heathen Magyars, cruel Mongol horse bowmen of an amazing mobility. These successes won, energy came back to Christendom like a great flood-tide. About the year 1000, after so many centuries of exhaustion, our European culture shot up in a happy hopefulness like that of the Greeks fifteen centuries before.

MUCH of the new vigor of Christendom was due to the success with which the early Middle Ages limited war. It is true that every freeman was armed, every gentleman not in Holy Orders thought of himself as a soldier, and the independence of the feudal lords led to plenty of local scuffles. Also the want of good communications and an organized police system permitted occasional banditry and disorder. The best known early medieval poem, the Song of Roland, is all about fighting and the loyalty or occasional treachery of vassals. Still the happy result was obtained. Politically and technically, wars were limited in time by the nature of the feudal obligation. A lord whose lands were attacked had a right to hold his vassals under arms until the invaders should be repulsed, but one bent on an offensive campaign in someone else's lands could keep his vassals in the field for only forty days in the year. After that he had to pay them, and medieval, social and economic arrangements made this very difficult. In common with almost all ancient peoples except the Romans of the later republic and Empire, medieval men forbade as usury the charging of any interest on an economically unproductive loan. Accordingly wars had to be financed from taxes. In turn, custom made taxes difficult to raise, for while vassals were theoretically taxable "at the mercy" of their lord, it was thought an outrage which only a man of monstrous wickedness would commit to raise the moderate dues demanded of the serfs who had replaced the ancient slaves at the base of the social pyramid. Just so, between the greater vassals and their over-lords or kings there was a strong feeling that "the king should live of his own," that is he should find money for his ordinary undertakings out of the rents and servile dues of the lands which he directly owned as a private individual and out of the customary feudal dues owed him by his vassals. Any additional moneys paid him from time to time on extraordinary occasions by his vassals were considered as free grants which might be given or withheld at the vassal's will. All told, therefore, the shortness of feudal service and the difficulty of raising money made it almost impossible to wage offensive war on a large scale or for any length of time. To undertake a short campaign was hardly worth while, for in the absence of disciplined infantry trained in seige work each of the innumerable castles could stand a long siege.

Still another technical and economic limitation was the high cost of full armor; a suit of it was worth a small farm. Accordingly the fully armored horsemen, whom we have seen to have been the medieval soldiers par excellence, could not be indefinitely increased in numbers. For centuries their superiority to unarmored men was enormous; although they could not break a determined infantry defensive in close formation, as the modern tank—to which they have often been likened since 1916—can break infantry in the open and without artillery, still they were formidable enough to justify the comparison. We have seen that they were expected to furnish the chief strength of an attacking force. Besides the restrictions on numbers and length of service, another economic arrangement limiting the intensity of medieval war was that of ransom. If you killed a hostile knight his son owed you nothing but hatred. If you captured him he would buy his liberty with as large a sum as he could possibly raise. Accordingly it paid better to take prisoners than to kill.

THE moral forces limiting war among Christian men drew their strength from the religious unity of the time. Christendom was one country, the difference between the men of one district and another was nothing to that of infidel and Christian. It is true that the Church was already divided between east and west, but a feeling of separation between the rank and file of the Orthodox or Greek church on one side and the Latin or Roman church on the other was slow to develop. West of the Adriatic religious unity prevailed. Accordingly religious influence was able to do much to lessen the destructive effect of war upon society. Sometimes this was done by arrangements such as the Truce of God which forbade fighting on or near church property, and all attacks on clerics, pilgrims, merchants, women, peasants, cattle and agricultural emplements. Throughout most of Christendom the Truce extended from Wednesday evening to Monday morning in every week leaving only three days and two nights for war between nobles. Even these three days were ruled out during Lent, Advent, the three great feasts of Our Lady, the Apostles, and certain other saints. Further, in a society acknowledging Christian morals, bandits and robber barons were working against the grain; everyone agreed that their deeds were evil, and their brutalities were denounced so that they were morally always on the defensive—we may compare medieval Europe with ancient Carthage or Aztec Mexico where no one seems to have denounced human sacrifice. The moral unity of the Middle Ages also limited territorial quarrels between governments; no right of conquest was admitted between Christian men, and disputes as to who should govern a given district arose only when it was doubtful which claimant had the better hereditary right. Men being what they are, such claims might now and again he false and hypocritical, but they were by no means negligible; unless an aggressor could show some solid appearance of right on his side he was at a grave disadvantage.

Great wars were rare because they had to be fought by volunteer armies and a good moral cause was needed to attract large numbers of volunteers.

ONE such great war was William the Conqueror's campaign of 1066. William Duke of Normandy had been designated by the childless king Edward the Confessor of England to succeed him, and William's claim had been solemnly acknowledged by Harold who nevertheless seized the crown on Edward's death. William was therefore morally able to raise a considerable army by putting himself at the head of a sort of vast partnership or stock company formed to enforce his right to the English crown, promising English lands to those who would support him. This he would have a right to do because in feudal theory all land was owned by the king who could grant parts of it to whomsoever he might choose as vassals, the great vassals in turn subgranting it to smaller men. Supporting a usurper was good reason for confiscation whenever a king saw fit. Sailing from Normandy at the end of September, William landed in England, defeated and killed Harold in a general action at Hastings in mid-October. The

battle was hard fought and included about fifty thousand men on a side. But it finished the business, making William king of England and leaving him with no more than a few years of local uprisings, chiefly against the occasional misconduct of some of his officials and soldiers. The time being completely without national feeling, the country presently settled down under his government.

The chief military work of the Middle Ages was against the infidel. Through their earlier centuries men were continually volunteering to help the Spanish Christians reconquer Spain from the Moors; the Song of Roland tells of a Spanish campaign of Charlemagne's. Next came the Crusades to recover Jerusalem, some of them on a great scale; the First Crusade is said to have mustered from six to three hundred thousand men. Even if one shares the old fashioned and now diminishing contempt of nineteenth century scholars for medieval historians, still such figures from such a time indicate the great military effort. Moreover the intensity of the struggle was that of "unlimited" war; the priests with the First Crusade asked leave to fight, and when the higher clergy of the army denied them this pleasure they said in effect: At least give us knives so that we can go out and cut the throats of the Mohammedan wounded! Evidently they felt that mopping up after an attack could not fairly be called fighting. Also the earlier crusading time saw frequent massacres. Nevertheless, just as the Greek wars against Orientals and the great Roman campaigns of conquest were fruitful wars, leaving civilization higher and society stronger than before; so in their own way the Crusades were not destructive but fruitful. Their great effort was put forth in accordance with the moral feeling of Christendom. Notwithstanding the tragic disappointment of their final defeat in the loss of Jerusalem and failure to reconquer the Holy City, they helped knit Europe together, gave new energy to our race, taught the West new arts, stimulating both commerce and the intelligence. Later in the Middle Ages a third crusading theatre was opened up, heathen Prussia and Lithuania.

The professional soldier typical of war throughout the first eight Christian centuries did not entirely disappear. Byzantine armies remained professional until the thirteenth century, they even maintained the high organization of the old Roman service and kept its tactical tradition until the loss of Asia Minor in 1071. In the West hired soldiers were limited in numbers, thanks to the economic arrangements of the time. A few were to be found in the military households or body guards of the kings. Also the military inconvenience of the short feudal service was such that there was a small floating class of cosmopolitan mercenaries ready to hire out to any prince who would pay—sad dogs, cordially hated, for they were largely bandits when in service and bandits pure and simple when unemployed. Occasionally they would decide a campaign; in 1215 King John of England checked his rebellious nobles and saved his dynasty by the use of such forces. For centuries, however, they were altogether subordinate to feudal troops.

The best testimony to the success of the medieval limitation of war is the great increase in the population and wealth of Christendom in the three hundred and fifty years between 1000 and about the middle of the fourteenth century, an increase which cannot be accounted for by any advance in physical science comparable to that of the modern world. No such achievements as the glorious Gothic churches of the thirteenth century, unequalled throughout human history for the variety and vividness of their sculpture, nor the majestic order and serenity of St. Thomas Aquinas' philosophy could have appeared in an age exhausted by war or any other cause.

THE medieval scheme declined. In 1188 the loss of Jerusalem struck its confidence a heavy blow. In 1204 the crusading enthusiasm was perverted to the capture of Christian Constantinople, perpetuating the quarrel between the Latin and Greek Churches. Soon after 1300 the Papacy, the organ of moral unity and moral authority in the West, having reduced to a shadow the Holy Roman Empire which had stood for unity in secular governments, overreached itself in its claim to supremacy over all lay governments; was humiliated and in a sense captured by the French Crown. These things, however, were but preliminaries. Shortly before 1350 there began the Hundred Years War between the Kings of France and the French-speaking Plantagenet House who were already Kings of England and now claimed the right to rule in France as well.

The Hundred Years War shows clearly how far the Middle Ages had weakened and yet how much of their limitation of war remained. First the claim of the Plantagenet Edward III, although by no means an empty, trumped-up thing like Frederic of Prussia's claim to Silesia in 1740 or similar aggressions since then, was nevertheless far-fetched, and the armies which supported it were no longer feudal; they were volunteer forces raised under royal "Commissions of Array," and their wages could be found for considerable periods, thanks to an increasing development of royal finance. Money economy was developing, and vassals were more and more willing to pay their overlords for exemption from armed service. The soldier's rate of pay was high, especially toward the end; in the campaign of Agincourt Henry V's archers were getting three times the wages of a skilled laborer. Much of the Plantagenet strength consisted in middle class infantry units armed with a new and powerful weapon, the long bow. Not only their composition but also their strategy showed a new spirit; with paid troops at their command the Plantagenets—unable to conquer France—were content to harass those over whom they claimed to rule, making war pay by raiding and pillage, ransoming towns and captured individuals. At the same time the new day surrounded the miserable business with a theatrical atmosphere of chivalry, typified by grotesque exaggerations of costume and the pageantry of arms. Toward the end of the long affair still another degradation appears: a systematic and cold-blooded cruelty morally baser than the mere brutality of the Dark and early Middle Ages. Thus at Agincourt Henry V's success at the beginning of the battle left him with a great number of prisoners including many of the noblest blood of France. Fearing lest his prisoners might be tempted to rise in aid of a possible renewal of the French attack, he ordered them all killed. When, partly from pity and partly from unwillingness to lose the rich ransom of so many noble captives, the English hesitated, Henry had the helpless men systematically knocked on the head by archers of his own bodyguard. The continued fighting naturally produced distress; in Paris toward the end of the long struggle men starved and wolves approached the city.

And yet notwithstanding the long agony of the Hundred Years War it by no means marked a complete breakdown of the medieval limitations. The armies were not large; although Edward III at Creçy had twenty-six thousand, the Black Prince at Poitiers had no more than seven to eight thousand and

Henry V at Agincourt only eleven thousand. On the moral side, the Papacy was continually trying to arrange a peace. Nor did the three generations of medieval fighting cause any such lasting social disturbance as the far shorter great wars of ancient and modern times. In the thirty-five years' interval of peace between 1380 and 1415 France quickly became prosperous again, and when the English were finally driven out the single reign of Louis XI again made her immensely rich—as the innumerable churches built in the flamboyant Gothic, with their wealth of carved stonework, abundantly testify.

About the middle of the fourteenth century, shortly after the beginning of the Hundred Years War, there occurred the Black Death, a plague which carried off millions—half of the adult population in many districts of Europe. Under the strain naturally following such a disaster, the peasants—for by this time most of the former serfs were in social fact although not yet in legal theory free peasants—rose against the feudal landed gentry. A flash of the "all men are equal" idea, with its inevitable accompaniment of class hatred, appears in these revolts, for instance in the couplet sung by the English rebels:

"When Adam delved and Eve span
"Who was then the gentleman?"

It is striking testimony to the strength of medieval social and military arrangements that, notwithstanding a disaster on a scale calculated to dissolve the most civilized communities, the rebellions were soon ended. We have seen that, unlike the commercial rich of today, the medieval gentleman was a soldier, that he and his retainers with their specialized equipment—great war horses, complete armor, etc.—were immensely superior to undisciplined and loosely organized peasants. In France, where the revolt was known as the *jacquerie*, the feudal gentry were particularly successful in putting it down by arms. Meanwhile the underlying moral unity of the time remained, so that (after the suppression of the various local rebellions) enough of the peasants' grievances were redressed so that there were no more peasants' revolts in Europe for more than four hundred years.

THE Hundred Years War and the Black Death with its subsequent peasant risings were not the only great disasters of the later Middle Ages. Other misfortunes not directly military weakened the moral and social system on which the medieval limitations of war reposed. There was a long division between rival claimants for the central organ of moral authority, the Papacy, which fell into a corruption shared in varying degrees by the body of the Church throughout Europe. The upper classes became increasingly wicked and cynical; where individuals remained pious their piety was of a twisted sort, so tainted by superstition that highly able men like the cruel soldier Henry V of England and the prudent and cunning Louis XI of France were not quite sane. Cruelty continued to increase. In the New York Art Museum there is a magnificently worked fifteenth century tapestry representing soldiers and prisoners. One soldier, having bound a wretch hand and foot and forced him to kneel, is deliberately disemboweling him! Several other disemboweled corpses are shown. The scene is thought to show the Roman capture of Jerusalem, at which Roman soldiers cut open certain wealthy jews thought to have swallowed valuable jewels. But certainly a time in which such an artist would choose such a scene clearly took a perverted delight in horrors. No wonder that the note of fifteenth century is one of gloom. Late medieval society felt itself borne down by many calamities.

Meanwhile the trading class gained ground, more and more claiming the right to enrich themselves as they chose, irrespective of the effect of their trafficking upon society. Backed by the middle class traders or business men, the kings also increased in power at the expense of the priests and nobles; in part their new importance corresponded to the greater complexity of civilization, we have seen that the change from a customary to a money economy increased the financial strength of the central governments; in part the new reverence paid to kings came because here and there the monarchies incarnated a new moral force, national sentiment. Insofar as men gradually forgot the old ideal of a united Christendom and prided themselves on being Englishmen, Frenchmen, or Spaniards, they came to reverence the old royal Houses which had been for centuries chief among the nobles and now were beginning to stand for the administrative and moral unity of whole provinces. In the fifteenth century, toward the end of the Hundred Years War, the French Crown took the important step of raising a standing army among their own subjects. The new national force, the "Ordonnance Companies" was not large, only nine thousand at full strength. It contained a large noble element, like any typical medieval unit. But it was permanent and regularly paid by the Kings, and the principle it embodied was to determine the future. At the other end of Europe under very different conditions the new Mohammedan power of the Ottoman Turks also raised a small but formidable standing army, the Janissaries.

THE social and spiritual changes naturally had their effect on warfare. The new signs of national feeling exasperated the quarrels between Kings into quarrels between peoples as well; the Hundred Years War which had begun as a dispute between two French-speaking families over a feudal inheritance ended in something like a national war. The new financial power of governments, based on the taxes levied upon the traders, gave an increased ability to hire mercenaries. Of these some were armored cavalry of the old type, but towards the end of the fifteenth century we also begin to find trained infantry such as had not been since the decline of Rome, well able to maneuver and capable of attacking feudal horse.

We have seen that medieval armies on the defensive in the open were accustomed to dismount. The English longbowmen were always used in connection with mounted or dismounted knights. Also the Middle Ages had seen occasional victories won by true infantry, by Scotchmen too poor to afford horses or Flemish town militia, but these battles—Bannockburn, Courtrai,—had been gained by short counter-attacks after the feudal cavalry had exhausted itself in persistent and unsuccessful offensives. Attacking infantry originally reappeared in Switzerland. The Swiss, by a persistence in drill equalled only by their persistence in rifle shooting today, actually taught themselves to move regularly and rapidly in large, deep formations although armed with one of the clumsiest of weapons, the long two-handed pike. This accomplishment, together with the natural combativeness of the mountaineers, enabled them first to free themselves from their feudal lords and then to become the chief reservoir of mercenaries in Europe. Before 1500 there were also trained Spanish foot, with a different tactic based on the sword and buckler like Roman legionaries, and soon afterwards units of

Germany mercenary foot are found copying the Swiss method.

The rise of infantry had been preceded by a decline in armored cavalry, these last had lost the art of maneuver before the foot rediscovered it. In the Dark and Early Middle Ages armor had been of chainmail backed by leather or wadding, the whole flexible and light enough to permit of long marches and rapid battle movements. The early medieval cavalry could not only make astonishing marches like John of England's eighty-mile dash from Le Mans to Mirebeau in forty-eight hours in 1202—with relays of horses, but even so, what riding! They were also, capable of rapid and precise drill movements like de Moutfort's at Muret in 1213. The replacement of chainmail by plate armor for man and horse so overloaded the mount that maneuvering became impossible; the overweighted beasts could not so much as turn at a canter without grave risk of falling. Even with such a weight of metal you could not armor the horse as completely as his rider; the beast's legs and belly had to be left unprotected. Accordingly the men at arms who had always been accustomed to dismount for a defensive would now often dismount for an attack—a practice for which his new and heavier equipment unfitted him. At Agincourt the English, to make their French prisoners helpless, had only to take the helmets off them. There was no need to tie them to prevent their escape, for the mud had already so tired them that they could not move. The desire for safety had produced clumsiness; in the same fifteenth century we begin to hear of men smothered or dying of heart failure under the mere weight of their own armor. Nevertheless it was the rise of true infantry, well trained and disciplined, which depressed cavalry rather than the decline of the latter.

THE rise of infantry was even more important to the social and military changes of the time than the discovery of gunpowder, as keen observers like Machiavelli clearly saw. Even without gunpower, numbers of trained foot capable of siege work like that of the Greeks and Romans and backed by governments wealthier than those of the Middle Ages, would in any case have shortened the long medieval sieges. It is true that cannon revolutionized siege warfare; there was a moment late in the fifteenth century when sieges were matters of days rather than of weeks or months. Moreover when permanent works were made capable of mounting cannon for counter-battery work against the besieger's guns, sieges again lengthened. These new works had to be of considerable area in order to prevent severe converging fire by the assailant. Accordingly the comparatively small highly fortified point, the castle, lost its value, and the fortified area had to be at least as large as a small town. At the same time cannon and the musket (so called because of the noise of the bullet, from the Italian *moschetto*, a little fly, also the source of our word "mosquito") altered open warfare; armor of a useful thickness became too heavy to carry. It was symbolic when the Chevalier Bayard, a man typical of the older time, was killed by a musket ball. All told, gunpowder hastened the change from medieval war which trained infantry and richer governments would in any case have brought about.

The nobles remained warlike; the earliest Spanish and French musketeer units were aristocratic; even as late as the French seventeenth century readers of Dumas will remember Dartagnan and the Three Musketeers. But as the sixteenth century opened, the typical armed man was no longer a vassal summoned to armed service by a feudal superior, he was paid by the king. Complex infantry drill by command had made fighting much more of a skilled trade than before, the technical superiority of the professional soldier over the feudal militiaman was now far greater. Only kings could afford the new artillery, which greatly strengthened them in suppressing rebellion, for the moral effect of the early cannon, crude though they seem to us, was enormous. Author after author of the sixteenth century, Rabelais for instance and Shakespeare, abundantly testify to it. Shakespeare marvelled at the soldier's courage in "seeking the bubble reputation even at the cannon's mouth"; Rebelais makes his daredevil Friar John say "Ha! Ha! I fear nought but the great ordnance."

No thinking man of today, caught as we are in national and class divisions, will wonder to hear that the medieval ideal of a universal Christendom died hard. In the fourteenth century Chaucer had fought creditably in the Hundred Years War against France, but when in the "Canterbury Tales" he imagined a good knight he said nothing of wars between Christians but took care to tell his readers that his hero had crusaded against the heathen Prussians. In the fifteenth Joan of Arc, the incarnation of French patriotism, proposed that English and French should stop fighting each other and join to recover Jerusalem. Even in the sixteenth century Francis I of France talked of crusading to the Holy Land. Nevertheless the old ideal did die; Francis himself in the heat of his quarrel with the Emperor Charles V was not ashamed to ally himself with the Turk.

THE names of Francis and Charles bring up the early sixteenth century Italian wars. Around the year 1500, while the moral unity of Europe was still doubtfully holding together under the corrupt Papacy, Italy was the cockpit of Europe. For more than three decades a series of wars developed the new technique of arms and intensified cruelty. The fighting was chiefly between the French and Spanish who were both trying to conquer the rich peninsula but both sides hired mercenaries—Swiss, Germans, etc.—wherever they could get them. At the beginning of the business, when the French had beaten the Venetians at Fornovo, the chronicler Commines tells how the captured Venetian men at arms, when knocked down and unable to rise unaided in their heavy armor, were butchered by the French servants and camp-followers with hatchets, three or four collecting about each prostrate victim and beating in the vizor of his helmet with repeated hatchet blows, "for otherwise they could hardly have been slain, they were so strongly armored." There was no peculiarly bitter quarrel between the parties, it was merely good fun for such a rabble to kill helpless men. Nor did any French gentleman see fit to intervene. In these wars we hear of great cruelties inflicted on the peasantry, considerable numbers of whom were hanged in mere savagery. When fortresses were stormed their garrisons were usually massacred. Towns taken by assault were mercilessly sacked with every sort of outrage; on one such occasion it was thought extremely noble of Bayard to have protected certain young ladies from rape. Clearly the medieval limitations of war, already so weakened, were about to collapse as Augustus' professional army system had finally collapsed in the ninth century.

The break came when Protestantism destroyed the moral unity of Western Europe on which the medieval scheme, including its limitations of war, had reposed. At first the full military consequences of the new religious movement did not appear. Although grave social disturbances soon occurred

and were savagely repressed both in the Germanies and in England, for some time there was no heavy fighting. Also the governments which had broken with the Papacy began to act on new principles; at the coronation of Edward VI of England it was proclaimed that the boy prince held his power of God alone and owed no moral duty, either in temporal or in spiritual things, to anyone on earth. In practice, this sounded a little like Machiavelli. But at first the political effect of the religious cleavage was not felt. The Catholic Emperor Charles V stood for religious unity and for the defense of Christendom against the Turk; when in 1527 an army of his sacked Rome, threatened the Pope, and murdered priests and cardinals right and left, the one rivalry between those of the cosmopolitan mercenary ruffians who happened to be German Lutherans and those who were Catholic Spaniards, or Catholics of other nations, was to see who could grab the most loot and commit the greatest atrocities. Such doings were still within the framework of late medieval war: comparatively small armies of savage hired soldiers of fortune under leaders of whom many were cynically ambitious, some as cruel as their men, and even the best unwilling or unable to prevent wholesale orgies of destruction and crime.

Great writers began to damn governments and their wars after a fashion unheard since the peace of Augustus fifteen centuries before. On the eve of the Reformation Erasmus, seeing so many princely coats of arms displaying eagles, remarked: "Of all birds the eagle alone has seemed to wise men the type of royalty—not beautiful, not musical, not fit for food, but carnivorous, greedy, hateful to all, the curse of all and, with its great powers of doing harm, surpassing them in its desire of doing it." Rabelais makes his good King Grangousier willing to go to almost any length of concession before taking up arms against the unjust aggression of the foolish Picrochole. Shakespeare, although willing enough to do a patriotic battle-piece like Henry V, savagely caricatured the generals of his time in the black and cynical tragedy of Troilus and Cressida.

Toward the middle of the sixteenth century, however, a powerful new element of popular passion was added to the witches cauldron. Throughout Europe great numbers of men came to believe it a religious duty to kill their enemies. The first civil wars between Protestant and Catholic were in Germany. Dying down there, they began to break out in France. Next it was the turn of Holland which revolted from Spain, and after thirty-seven years of fighting made good its independence. It was the Calvinism of the Hollanders, together with their desire for local independence from Spain, that inspired the desperate resistance of the Dutch towns besieged by the Spaniards. The few Spaniards could beat any number of Dutchmen in the open, but it is a military axiom that in position warfare, where there is no opportunity for maneuver, numerous and enthusiastic troops of low military quality can often make a showing against high quality units. On the other hand it was the Catholicism of the Parisian populace, together with their desire for French national unity, which avenged earlier massacres of Catholic nobles in the south by the great massacres of St. Bartholemew.

Naval warfare again became important. Outside of the Mediterranean its instrument was the ocean-going sailing ship in which the coasts of three-quarters of the globe had been discovered within a single long lifetime. Armed with cannon on the broadside, the victories of the sailing fleets not only helped assure Dutch independence from Spain and repulsed the Spanish attack upon England, they also affected land warfare because overseas trade became a chief source of the wealth by which armies could be supported. This was especially true of Spain whose vast stream of bullion from Mexico and Peru financed her armies and was as important as the high quality of her infantry in her domination of Europe. Toward the end of the century, however, although her decline was at first unperceived, the dominant military power and Catholic champion, Spain, was weakening; and no wonder, for she had been defending Christendom against the Turk in the Mediterranean, discovering and colonizing half the world, and fighting for the Catholic cause in half the provinces of Europe, opposing alternately the Protestant Germans, the French, the English and the Dutch.

In 1593 the French civil wars ended. In just over thirty years no less than eight had been fought, most of them short but the eighth lasting ten years, including a desperate resistance of Catholic Paris to Henry IV while he remained Protestant. The armies on both sides were largely of cosmopolitan mercenaries. They were always small, usually under twenty thousand; Henry at his strongest commanded only twenty-five thousand. It was the duration of the fighting that made it terrible.

After such a nightmare, opinion naturally hardened in favor of order; a very passion for order flames in Malherbe's polished lines to Louis XIII, setting out to besiege the Huguenot city of La Rochelle in 1627. The poet calls upon the king to exterminate the faction like vipers.

> "A hundred Decembers have tarnished the plains,
> "And a hundred Aprils painted them with flowers,
> "Since their brutal madness has caused among us
> "Nothing but tears."

Rochelle surrendered only when nearly two-thirds of its twenty-eight thousand souls were dead, and the survivors of its fighting men too weak from starvation to use their weapons.

IN 1618, when the long agony of the religious wars had already lasted for nearly a century, the Thirty Years War began. On the Catholic side the leader was the Hapsburg Holy Roman Emperor of Austria, helped by his Hapsburg cousin the King of Spain, and by the Catholic German states. On the Protestant side there were at first only the Protestant German states, but later Sweden intervened under her King Gustavus Adolphus, one of the great captains of history. Some help was received from England and Holland, and more important still—both as deciding the issue and as a landmark in European affairs—Catholic France under Cardinal Richelieu preferred nationalism to religion as a political motive and financed the Protestants from a desire to strengthen herself against the Hapsburgs.

The armies of the Thirty Years War, although larger than those of the French religious wars, were seldom very large; the peace footing of the French standing army was only fifteen thousand; on a war footing Sweden could recruit and keep up only the same number. Usually the entire forces of both sides were nearer fifty than a hundred thousand. The imperialists may once have reached a hundred and seventy thousand, a greater number than any force since the First Crusade, but it was an effort impossible to maintain. To concentrate sixty thousand men for battle was an extraordinary feat; Gustavus' first great fight was between forces of forty and forty-five thousand, his second between twenty and thirty thousand.

What made the war so terrible was its ferocity. Massacres on such a scale and so long continued had never been seen in Europe. The Catholic general Tilly, who fought until mortally wounded in action at seventy-two, was a devout and greatly respected man, an enemy once called him "The honorable old Tilly, whose acts were so heroic that after his death they were his everlasting monuments making his name eternal." Yet when someone complained of the crimes of his troops he answered only "Do you think my men are nuns?" Apparently he thought it was to be expected that soldiers should steal, rape, and kill. In fact it was the army under his command which at the taking of Magdeburg behaved more wickedly than any savage tribe, killing every man, woman and child they could find. They also worked hard at destroying the place—except the cathedral to which Tilly went in state for a solemn Te Deum! He seems to have made no effort to check the slaughter. Perhaps forty thousand may have fallen. Although the forces of the other great imperialist commander, Wallenstein, never achieved any single mass production of atrocities to compare with Magdeburg, they were equally cruel. Once Wallenstein, summoning a town to surrender, announced that he would not leave alive so much as a child in its mother's womb if not admitted. Gustavus had some success in preventing his well disciplined troops from killing non-combatants, but both sides made it a practice to massacre the garrison of a besieged place when taken by assault. Oddly enough to our thinking, many of the survivors of a beaten force, when they happened to be captured and not massacred, would enlist in the victorious army like the survivors of the Soudanese who enlisted under their British conquerors. What the cosmopolitan mercenary of the religious wars really enjoyed, that is unless his ferocity was devout in motive, was loot and butchery in whatever cause. Scott's character of Dugald Dalgetty in the "Legend of Montrose" is a sympathetic portrait of the type. Since they were seldom regularly rationed and paid, they usually had to live off the country. Moreover the armies were followed by great trains of camp followers of both sexes; it is said that one imperialist force of forty thousand had a hundred thousand of them, and these vast swarms helped to devour the country like locusts.

THE destruction caused by the thirty years of unlimited war exceeded anything in European history; three-quarters of the entire German population died. In one not especially exposed group of twenty villages, the loss was eighty-five in the hundred. Careful German writers say that certain agricultural districts did not regain their former productivity for two centuries. Cannibalism was frequent; the dead bodies of condemned criminals were eaten. Once, in Alsace, prisoners were actually killed for food.

Notwithstanding the frequent popular commotions which had accompanied the beginning of the Protestant movement, the religious wars bred no social revolts. On the contrary, governments continued to strengthen their hold on their peoples. For instance, Cromwell with his army at his back was absolute master of England as no king had ever been. With a large and strongly commanded regular army at its orders, an executive is more secure against insurrection than under any other military system because long service professional soldiers form a sort of corporation or guild with a separate public opinion of their own. Again, unlimited war is the natural result of popular passions, so that the savagery of the religious wars merely reflected the intensity of feeling stirred up by the religious quarrel. After the horror had gone beyond a certain point, society was numbed.

Moreover, although the medieval limitations of war had so fearfully broken down that thirty years of it in the seventeenth century had produced a vaster nightmare than the Hundred Years War of the fourteenth and fifteenth, still much of the medieval social scheme remained. Government was still hereditary, indeed the right to govern was increasingly held to be divine as religious unity receded. Although the old "economic morality" restricting competition and thereby preventing the great from impoverishing the small was everywhere weakened, enough of it remained to lessen economic oppression. Everyone still professed belief in a definite morality and in divine judgment after death.

Nevertheless as the Thirty Years War ended in 1648, with no decision in favor of either of the two parties which had so long divided Europe, tired men might well have despaired as they despair today. As such men now see no end to the devouring curse of democratic war, so they might then have said "Religious war must go on until Europe is destroyed. The question at stake is so important and the two sides so evenly balanced, especially now that Catholic France has inexplicably decided to side with the German Protestants, that no limitation of war is possible. There is no remedy, and our civilization must continue tearing itself in pieces."

Nothing of the sort happened. Our ancestors, seeing that they were approaching a precipice, sharply faced about. By an unspoken but real agreement they stopped fighting unlimited wars.

A Medieval Aspect of Fort Monroe, Virginia.

ARMY ORDNANCE

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Month by Month

Ordnance and National Recovery

ALL friends of national defense will learn with considerable pleasure that ordnance is included among the projected public works in the National Recovery Bill as sent to the Congress by the President on May 17th. Section 202 of the proposed bill itemizes the kinds of work which may be authorized by the Federal Emergency Administrator of Public Works who will administer the law. Included in these are the construction and repair of public highways, conservation and development of natural resources, construction of low cost housing and slum clearance projects. The wording of the bill which relates to the manufacture of military and naval equipment is as follows: "If in the opinion of the President it seems desirable, the construction of naval vessels within the terms and—or limits established by the London Naval Treaty of 1930 and of airplanes required therefor, and construction of such Army housing projects as the President may approve, *and provision of original equipment for the mechanization or motorization of such Army tactical units as he may designate;* provided, however, that in the event of an international agreement for the further limitation of armament to which the United States is signatory, the President is hereby authorized and empowered to suspend, in whole or in part, any such naval construction or mechanization and motorization of Army units."

While the proviso may seem so broad as to prevent the mechanization and motorization program from materializing, it will appear on closer analysis that the prospects are not nearly so remote. Even if the disarmament discussions lead to some sort of an agreement it most certainly would appear that nothing can be agreed to which would prevent the United States Army from replacing much of its obsolete equipment—unless the day has come when we are to have no Army whatever. All enthusiastic talk of Geneva statesmen to the contrary notwithstanding—that day has not yet come. The need for new truck equipment, new gun mounts, new antiaircraft batteries and new "unaggressive" weapons of all kinds and classes is the order of the day. Hence the proviso is not so sweeping as to make the whole undertaking meaningless at all.

As we have taken occasion to point out in these columns on innumerable occasions, no public works provision is more useful in accomplishing the urgent requirements of relief than is the mechanization and motorization of the Army at this time. Just as in the case of naval building, so also in military manufacture at least 85 per cent of the expenditure goes to labor. No other public works involve so many and so widely separated industries of the nation. The Navy League stresses with regard to shipbuilding, "Day laborers, miners, skilled mechanics, mill and factory operatives, all participate in the employment furnished and at nominal wages and without direct additional overhead cost to the government. The farm, the forest, the mine, the mill and the factory, all contribute their products—the products of American labor." Furthermore job relief cannot now face long delay in getting into operation. That was the trouble with the public buildings program, for instance, where sites had to be selected and bought, architects' plans made and innumerable other long drawn-out delays so that very little of the work actually was begun. Meanwhile the laborer had to bide his time with more and more distress. While public roads may be begun quickly and while the replacement of city slums by low cost housing involves no delay, the naval and military program could be gotten under way at the drop of the hat. It is only a matter of taking out the blueprints and placing the contracts. In many cases the mechanics could begin their work immediately.

Just how much of the public relief fund should be allotted to the mechanization and motorization phase of the national program is a debatable question. Students of the subject have conservatively estimated that an allotment of $50,000,000 would help do the trick. Added to this should be sums for other necessary military works authorized in the bill, the above figure applying merely to mechanization and motorization.

Early reports are to the effect that Brig. Gen. Hugh Johnson, well known to the Ordnance confraternity for his splendid World War service and since then a contributor to these pages, may become the administrator under the recovery bill. If these rumors are correct, it is certain that General Johnson by experience and study has the proper understanding of ordnance in the relief picture. He knows the military as well as the administrative sides of the question. More and more the national consciousness is veering to the method of the War Industries Board for the solution of this peace-time emergency. Organization along the lines of allocations, priorities and even price-fixing, differing from the war-time machine only in degree, hold out the self same victory for the country whether the objective be internal or external.

It is not belittling any disarmament endeavors to observe that unless we are again out-traded as we have been so consistently in the past, nothing will transpire to give good cause for not embarking upon the mechanization and motorization features of the recovery bill as soon as it shall have become a law. It will do the heart of the country good to see our old World War trucks replaced by up-to-date designs and our gun carriages, antiaircraft directors and tanks come into their own in goodly numbers. The Army of today will profit by it, so will the laborer and manufacturer of today and so too will the national defense for a decade or more to come. That decade is bound to see talk replaced by action one way or the other.

ARMY ORDNANCE extends felicitations to Hon. Harry Hines Woodring who entered upon his duties as the Assistant Secretary of War on Army Day, April 6th. The new head of the industrial mobilization forces of the War Department is not new to the Army or to industry. During the World War he enlisted in the Tank Corps, rose to the grade of sergeant, attended the Tank Corps Officers School at Camp Colt, Gettysburg, Pa., and was commissioned a second lieutenant. He was scheduled to go overseas when the Armistice was signed. A former governor of Kansas, Mr. Woodring is also a former vice-president of the Kansas Bankers' Association and past state commander of the American Legion. Upon assuming his new office Mr. Woodring made the following significant statement:

Assistant Secretary of War Woodring

"I enter upon my new duties with the keenest anticipation. My personal acquaintance with the Army dates from 1917. At that time I formed my impressions, first as an enlisted man and later as a junior officer. More recently, as Governor of Kansas, I have thoroughly enjoyed many real friendships with Army personnel. I have great respect for the capabilities and methods of the Army, and I have most pleasant recollections of the group of Army officers with whom I have come in contact. I look forward to the opportunity of renewing some of those friendships.

"The responsibilities of the Assistant Secretary of War are spread over a nationwide field. I hope soon to inspect many of the installations in this field and to meet the officers charged with their immediate control. In the meantime I want the Army at large to realize the pleasure with which I anticipate renewed relations with the people of the Service. I have a deep interest in maintaining the prestige of our Army and in promoting the welfare of its personnel."

The Army Ordnance Association is pledged in a very particular way to the advancement of the new Assistant Secretary's greatest responsibility, that of industrial war planning. As he becomes familiar with the details of those plans and the importance of their active advancement he will realize that the coöperative basis on which they depend is an enduring relationship of outstanding value. We speak for all members of the Army Ordnance Association in assuring the new Assistant Secretary that as the head of industrial war planning for the Army he will have the same wholehearted support which our organization has been honored to give his predecessors for the past fourteen years.

IN connection with the discussion of the Arms Embargo Resolution by Judge John Bassett Moore in this issue of ARMY ORDNANCE, it should be said that since the article was prepared the resolution has been amended by the Foreign Relations Committee of the Senate. The objection raised by Judge Moore to the resolution in its original form as passed by the House of Representatives has been very materially modified. The amendment, which is said to have been agreed to by the Secretary of State and the Chairman of the Committee, restricts the use of the proposed embargo authority to stop exports of arms to all parties in international disputes. Authorship of the amendment is credited to Judge Moore.

Arms Embargo

In the opinion of Senator Johnson of California, the adoption of the amendment "retains the status of neutrality of this nation." That is to say, action, whether punitive or passive, against any individual nation could be taken only as at present under authority of a joint resolution of Congress. Much opinion has been expressed by observers to the effect that the resolution as now amended qualifies—if indeed it does not partly nullify—the abandonment of neutrality as pronounced recently at Geneva by our representative.

The complete text of the Arms Embargo Resolution as amended by the Senate Committee follows:

Joint Resolution to prohibit the exportation of arms or munitions of war from the United States under certain conditions:

Resolved by the Senate and the House of Representatives of the United States of America in Congress assembled, That whenever the President finds that in any part of the world conditions are such that the shipment of arms or munitions of war from countries which produce these commodities may promote or encourage the employment of force in the course of a dispute or conflict between nations, and, after securing the cooperation of such governments as the President deems necessary, he makes proclamation thereof, it shall be unlawful to export, or sell for export, except under such limitations and exceptions as the President prescribes, any arms or munitions of war from any place in the United States to such country or countries as he may designate, until otherwise ordered by the President or by Congress. Provided, however, that any prohibition of export, or sale for export, prohibited under this resolution, shall apply impartially to all the parties in the dispute or conflict to which it refers.

Sec. 2. Whoever exports any arms or munitions of war in violation of Sec. 1 shall, on conviction, be punished by a fine not exceeding $10,000 or by imprisonment not exceeding two years, or both.

THE dire threats under which the entire personnel of the Army is laboring these days have done more to weaken morale and disorganize a smooth-working machine than any peacetime situation through which our military establishment has had to exist. It is proverbial with us to scrap our defense machine even in the face of conflict. We did it after the Revolutionary War with the Army, we did it with the Navy after the War with France, we did it during and after the War of 1812, the Mexican War, the Civil War and the Spanish American War. It looks as though the full brunt of this policy is now descending on the Army as a belated aftermath of the World War. We hope almost against hope that it will not be so. It will be so, however, if the Army is to take a cut in its appropriations for the next fiscal year of $144,000,000 as has been announced. The severity of this reduction can be understood best by recalling that next year's appropriations for military defense have already been cut more than $100,000,000 under the current year's appropriation. In other words, the War Department was allowed for 1933 $467,458,000. For 1934 the Congress cut that allotment to $349,840,749. The Budget Bureau now asks that this reduction be further reduced to $205,840,749, which is less than half the appropriation of 1933. In plain words, such a ruthless cut can not be made without putting the Army out of business, because the Army as we know it will be put out of business if it has to endure a reduction in officer strength of from 2,000 to 3,000, the retirement or dismissal of from 12,000 to 13,000 enlisted men, the elimination for the time being of citizens', reserve officers' and National Guard training camps with a severe curtailment of drill periods of the latter, the abandonment of some Army posts, reduction in pur-

Economy and Army Morale

chase of matériel, and cuts in allowances for transportation. As the *Washington Star* observed editorially, "Nor is the amount of the reductions less interesting than the method of making them. As in the case of other proposed curtailments, the objective sought is a horizontal cut to an arbitrary figure. The sacrifices necessary to achieve this reduction are of secondary importance and are, apparently, outside the scope of Budget Bureau considerations. The task of the professional military men is no longer to build a military machine adequate to meet the demands of national defense, but to take the jigsaw puzzle fragments left after the Budget Bureau's sawing and to find out what the resulting picture will look like.

"That it will jar all preconceived notions of national defense is beyond doubt. And it is a question whether the newly-acquired sanctity of Budget Bureau recommendations should serve to prevent general understanding of the full effect of the Budget proposals upon the Army and national defense. There can be no such understanding until it is made known what retrenchment steps must be taken and what new policies are thus established to come within the limits laid down by the Budget Bureau, whose official personnel at the moment is concerned merely with figures."

The Army itself by its conduct in recent months has shown conclusively that it desires to go the limit in sane retrenchment to meet the economic situation, on the sound theory that it ill becomes any proponent of Federal retrenchment to hold out for his own particular interest as against all others. The soldier has uncomplainingly taken his medicine to the extent of pay reductions to the point where his monthly income is now $17.85 even though he has been given the pleasant duty of conditioning embryo foresters of the Civilian Conservation Corps, who receive $30.00 a month. Officer personnel has been even more heroic. The corps of officers has accepted uncomplainingly drastic reductions in pay. Now it appears to be faced with actual dismemberment.

All of which comes down to the fact that in addition to personal sacrifices the United States has available for defense smaller combat forces than those of any other important nation in the world. Smaller even than Germany is permitted under the drastic repressive conditions under the Versailles Treaty. It will be worse than shortsighted if in the retrenchment process officers of such branches of the Army as the Ordnance Department who are engineers and trained staff specialists of the highest order are allowed to be removed from the rolls. Here at least is a profession which has little or no counterpart in civilian life, and when we look for replacements as we eventually must, it will be a sad day to find that there are none.

Some cuts in Army expenditures are in order of course. Staff organizations in many quarters could be reduced to advantage, combat units could be concentrated in fewer posts, other individual—and of themselves more or less inconsequential—economies could and should be effected, but a major revision of our military strength such as the proposed reduction in expenditures will require, may well prove to be more harmful than any of our many national defense follies in all our history.

Secretary Dern's pledge, given during an address on June 6 at the Pennsylvania Military College, that the number of officers would not be reduced at this time comes with real assurance. So long as the Department and more particularly friends of the Department endeavor to meet the economic situation without destroying the framework of national defense the horizon is clear. It must remain so.

One Hundred Years of the Bomb and Flame

THIS year of grace is a significant one in the history of American ordnance. It is the hundredth anniversary of the adoption of the ordnance insignia, the time-honored bomb and flame, oldest of all American military devices. At that there is some doubt as to whether the flaming bomb was officially adopted in 1832 or 1833. Our limited researches incline us to the latter year because the first recorded evidences in the books are the following letters, which we quote for the record:

"Ordnance Office, War Department,
Washington, May 9, 1833.

"Sir: I enclose herewith for your examination and decision the specimen of a button proposed for the Ordnance Corps. If it should not meet your approbation, such changes will be made in it as you may direct.

"An early answer is respectfully requested, in order that the officers may be enabled to prepare their uniforms for the 4th of July next.

"I have the honor to be, sir, respectfully, your obedient servant,

GEO. BOMFORD,
Colonel of Ordnance.

MAJOR-GENERAL A. MACOMB,
Commanding the Army."

. . . .

"Ordnance Office, War Department,
Washington, May 30, 1833.

"Gentlemen: In answer to your letter of the 24th instant, transmitting a button with the device of a 'bomb bursting, and two cannon crossing each other,' I have to inform you that it has been adopted by the General-in-Chief. All buttons, therefore, that may be required in future to supply the corps of ordnance will be obtained from you; of which circumstances, the corps and Mr. Callender Irvine, the commissary general of purchases at Philadelphia, will be duly notified.

"Respectfully, your obedient servant,

GEO. BOMFORD,
Colonel of Ordnance.

MESSRS. J. M. L. and W. H. SCOVILL,
Waterbury, Conn."

Whether the actual adoption occurred in the preceding year or not, 1933 marks the passing of a century since the ordnance insignia first appeared on the uniform. None of the other devices used in the American service can trace their origin to such a distant date although the crossed cannon of the artillery, which were adopted in 1834, are an extremely close second.

In this connection it may be of interest to recall the seniority of the various military insignia. The ordnance device is the oldest of present insignia. Also it has antiquity antecedent to its American adoption since it was brought into our service from the British where it had been used by the Grenadier Guards, the Royal Engineers and the Royal Horse Artillery. In the American Army the flaming bomb was used also by artillery until 1834 when the traditional crossed cannon of that arm were adopted. In 1901 a change was made in the crossed cannon device by superimposing a wheel for Field Artillery officers and a projectile for those of Coast Artillery.

Next in order of seniority is the castle of the Engineers which first made its appearance in 1840. The crossed saber device of the Cavalry was adopted in 1851. The caduceus of the Medical Department arrived in 1851; it was temporarily discontinued in 1887 when it was replaced by the familiar red cross and returned again in 1902. It has been the emblem of physicians since before the beginning of the Christian era.

The crossed flags of the Signal Corps came into being in

1868. In 1872 appeared the shield of the Adjutant General's Department and in 1875 the crossed rifles of the Infantry. While a crescent was adopted for the Subsistence Department in 1877 it was not until 1885 that we find the first evidence of the Quartermaster Corps insignia, at that time a key and pen. In 1896 the wheel and eagle were adopted completing the present insignia.

The Pay Corps, like its present survivor the Finance Department, adopted a diamond as its device in 1896. The wreath, sword and pen of the Judge Advocate General's Department appeared in 1890 and the sword and fasces of the Inspector General's Department in the same year. The Chaplain's emblem, the Latin cross, was adopted in 1898, prior to which time a shepherd's crook had been used. The insignia of the Jewish chaplains was adopted in 1918 and consists of the Mosaic tablets surmounted by the star of David. The present insignia of the General Staff was adopted in 1904. The crossed chemical retorts with the benzene ring of the Chemical Warfare Service, the tank supported by a salamander of the Tank Corps, the winged railroad wheel of the Transportation Corps, the automobile wheel and winged helmet of the Motor Transport Corps and the wings and propeller of the Air Corps are all adoptions of World War days.

It is more than fitting that the centenary of the ordnance bomb and flame should be commemorated with at least passing recognition. Its simplicity harmonizes with the armament of days gone by and the action it connotes is applicable with equal force to the weapons of our own day. This traditional device will, we trust, in another hundred years still represent the material achievement and the high morale it stands for today as faithfully as it did in the beginning.

Our Army, Geneva and Disarmament

AFTER the manner in which Senator Glass dropped a grenade into the Morgan hearings before the Senate Committee when he asked "What's it all about?", we wish that someone might as forcibly put the same query to the Geneva conferees on disarmament. The time is ripe for a clarification of ideas because the Conference is fast moving to the stage of confusion worse confounded. And so is the public mind. John Citizen reads on the front page of our daily papers that Mr. Norman H. Davis, our representative at Geneva who is a trustee of the Carnegie Endowment for International Peace and a member of the League of Nations Financial Committee, repudiates on behalf of the United States the American doctrine of neutrality which has been the corner-stone of our foreign policy for a hundred and fifty years. On the same front page on the same day John reads of a first class war now going on in which Japan threatens to continue her onward sweep to the Yellow Sea. What's it all about? asks John and to good purpose.

We take the liberty of presenting a few elementary observations on the subject which, although elementary, some people forget them nevertheless, while others have not recognized them even for the first time. After all the problem comes down to elementary terms indeed. Consider (1) the size of the United States Army, (2) the equipment of that Army, and (3) World conditions. As to the size of our Army, emphasis has been placed again and again on the one cardinal, historically constant principle of our national defense philosophy, namely, that our military policy is defensive and not offensive. In pursuance of that principle studies have been made by the War Department during the past decade of the minimum army required for our country and its possessions on a defensive basis. Further, the present size of the Regular Army is less, both in commissioned and enlisted personnel, than the figures arrived at by any of these studies. Further still, compared with any foreign army on any basis, whether it be number of soldiers per capita of population or number of soldiers per unit of wealth, our Army is weaker than any. It should be remembered that the reasons why we need any army at all include the guaranty of internal order, the training and instruction of the civilian components—the National Guard, the R.O.T.C. and the C.M.T.C., and likewise, but not the least important, through our military schools and training centers to keep alive a knowledge of the military art and its development. The present size of our Army provides only moderate means for carrying out these purposes. In the premises we have yet to see a good yardstick which, applied to our Regular Army, would indicate that it is above the minimum requirement in size.

When we consider the equipment of our Army in the light of current babblings some matters of fact are not to be overlooked. There is no weapon that does not have an offensive as well as a defensive value. Experts in international peace—if any—who say that there is a clear-cut line of demarkation between offensive and defensive arms are shadow-boxing with words. When such individuals battle with facts they must realize that a boxer—light weight or heavy weight, amateur or professional—has an offensive weapon in his right fist when he delivers a blow and a defensive weapon in the same fist when he blocks a blow. Quite absurd under the circumstances for any boxing commission to rule out all contestants whose fist diameter exceeds so many inches on the score that said contestant's right fist, being over the allowed dimension, is all offensive! Yet that is just what the Geneva "experts" undertake to do on armament. If they really mean what they say they mean then why stop at weapons of more than six inches in caliber. When attacking, a machine gun is not altogether a drug on the market, neither is it when defending.

If the grand pronouncement of the Geneva experts is gospel and their inspired fiat that artillery of six-inch caliber and above has only an offensive value, what about our seacoast artillery of fixed position which is purely defensive? Our 155-mm. howitzers and our G.P.F.'s can be readily used for seacoast defense by providing a simple turn table. The same applies to our 240-mm. howitzers. As to defense values of these weapons, we need only recall that howitzers emplaced behind hills caused considerable damage to Allied ships at the Dardanelles.

And so we come to aircraft, tanks and poison gas. Men in their senses dare not attempt to shackle the inventive genius of mankind in the development of peaceful products. Aircraft commercially cannot be held down and should not be. As the engineering of aircraft progresses for civil and commercial use there is always the application of that progress to war-time uses. In other words a nation fights a war with what it has. When horses were the only means of locomotion, armies were horsedrawn; when the automobile came on the horizon and the horse declined, the animal receded as a war potential. With aircraft and tanks it is the same. When

men stop thinking about improving their peace-time livelihood they will stop thinking about war-time applications of peace-time advancement. The answer to all the inhibitions against using one particular thing or another in war lies simply in this: the restless mind of man cannot be harnessed in its delving into science, it constantly seeks improvement first for the enjoyment of life and when that enjoyment is threatened then the unoffensive machines of peace become the offensive machines of war. When thinking stops so will progress. You cannot stop people thinking any more than you can stop them drinking. No one in his senses hopes that they will ever stop doing either.

A look at world conditions makes the disarmament snarl extremely mystifying. Nothing has happened to remove the old sore spots. The Polish Corridor remains, the Silesian Border remains, no one knows what Hitlerism may do. Japan while marching on to the Yellow River demands an increased naval ratio and apparently will take it whatever the other nations may say. And so it goes.

In the light of our traditional policy of defense the United States Army never has and does not now need to be demilitarized, it needs only to be kept at the proper strength and in the highest efficiency—both in men and munitions. One of the best proposals for individual efficiency is that advocated by General MacArthur who urges that teeth be put into the Class B law. Such a vehicle will do more to keep efficiency at high level than any amount of arbitrary backing and filling. The General's testimony on this subject before the House Military Affairs Committee was a splendid instance of what sane solutions will do for keeping the Army on its toes. Then the wisdom of giving the Army the job of conditioning the Civilian Conservation Corps is real headwork. These measures show that our own domestic problem can be handled satisfactorily.

It is only when we try to be magnanimously meddlesome in extraterritorial politics to the extent of striking our own breasts because we are overarmed that we begin to look ridiculous. It is laughable indeed when we admit that we have too many men in our Army; it is side-splitting when, like the theologians of old who went into tantrums over how many angels could sit on the point of a needle, we get into a lather about offensive and defensive weapons; it is down right tragi-comedy when with volcanoes all about us, some in eruption and others sure to erupt, we put ourselves on our own "preferred list" as armament Pollyannas. It is about time that the Geneva "experts" come down to earth and that we, on terms of friendship for all, maintain our military policy of defense in quality and quantity to meet our needs.

More Reason for Industrial War Planning

THERE never was a time when the industrial war planning activities of the War Department assumed greater significance than they now have. This is because of the far-reaching effect of the National Industrial Recovery Bill before the Congress. There is no doubt that the new order will represent a marked departure from the old. Business will take on many new conceptions. We are told by students of this legislation that we are about to have a new epoch with enlightened social control of industry and finance. In the words of *Business Week* "This is a new road for us . . . guidance of an industry council through the next few years calls for the best brains and the strongest character to be found within its ranks." In similar vein Senator Wagner of New York says that we shall have "a widening conception of business—that all business is affected with a public interest. That is the necessary consequence of the growing complexity of our economic machinery and of the increasing interdependence between one state and all states, between one industry and all industries, between employment anywhere and everywhere."

Since we are thus on the threshold of a new business outlook students of national defense will indeed fail in circumspection if industrial war planning does not keep abreast of the new order. War plans built on an older conception may prove eventually to be worse than useless. Hence we see that industrial war planning also stands at the threshold of what will be for it a new order too. Industrial mobilization in time of war has for its foundation stone the peace-time industrial structure of the United States as we find it. Consequently the entire philosophy of industrial preparedness to be effective must shape its course constantly and continually in the language and along the route which peace-time industry follows. Our studies since the World War in this untrodden field have certainly convinced everyone interested in the soundness of this policy and all friends of the movement look to an energetic pursuance of it under the new order with renewed application and energy..

Evolution of the Semiautomatic Rifle

READERS of this Journal have had presented to them in this and the preceding issue an unusual study of automatic arms by Major Hatcher. The discussion offers for the first time anywhere, we believe, a comprehensive explanation of breech closure mechanisms of the principal arms which have met with more or less success in the last generation. One salient fact stands out quite prominently.

While this article will, it is thought, give the reader a general idea of the various mechanical solutions involved in the breech closures of automatic firearms, limitations of space have unfortunately made it impossible to touch on many other vital problems connected with automatic rifle and machine gun design. For example, it is fairly obvious to anyone that to be successful a semiautomatic rifle must look like a rifle and not like a hoe or a crutch. Too often the inventor loses sight of such simple requirements and allows his mechanical solution of the breech closure to influence the shape of his final creation.

Then there are the limitations of weight and heat. It would be fairly easy to make almost any kind of mechanism if space and weight were unlimited, and the problem of designing a semiautomatic rifle would be greatly simplified if the barrel did not get almost red hot after just a few clips of ammunition had been fired.

It will be readily understood from this brief allusion to some of the difficulties encountered that the life of the firearms designer has been no bed of roses. It is in the secondary features such as the shape, weight, heat, method of feeding, design of sights, etc., that we must look for the explanation of the fact that it has taken over a third of a century of intensive effort to finally produce a semiautomatic rifle good enough to win tentative adoption from an Army board.

General Hagood's Reorganization

An Editorial

WHEN Maj. Gen. Johnson Hagood, Commanding General of the Seventh Corps Area and the Fourth Army with headquarters at Omaha, Neb., testified before the House Military Affairs Committee on April 12th, his plan to reorganize the War Department and cut the costs of the Army created quite a sensation. The proposed plan was not new but its revival came at a time when the entire Army was under a constant barrage of enforced retrenchment and tended to muddle the outlook rather than clarify it. That this was the result of the news of General Hagood's testimony is a subjective condition rather than an objective one for no other reason than that the state of mind of the Army is the morale of the Army. One's state of mind is dangerous to efficiency, to say the least, when it labors under threats of drastic changes, the particulars of which it knows little or nothing, and when it has added to this a proposed major operation which would not only envolve plastic surgery but the removal of the heart besides.

Of course, the merits of General Hagood's proposal should be weighed judiciously whether the occasion for its consideration is propitious or not. After all, the General did not advocate his plan out of a clear sky. The cogent and compelling reasons upon which much of it is based were first elaborated in his book "The Services of Supply" which friends and opponents of the present system have had ample opportunity to digest since its publication in 1927. Competent opinion has shared General Hagood's feeling that the dominance of a general staff as now organized and an occasional unwise use of power contain more disadvantages than did the old bureau system; students have debated with good cause the need for the chiefs of branches as they now exist; observers have stressed the top-heavy organization apparent in some instances. These are all matters of administration. With few exceptions they may be laid to misinterpretations of the National Defense Act rather than to defects in the Act itself. If economy and efficiency require that the present setup must be modified, then General Hagood's analysis had best be considered on its merits now. Otherwise pruning may be done simply for pruning's sake with little or no regard for the complete design.

GENERAL HAGOOD proposes to reorganize the War Department and the General Staff along natural functional lines creating five main divisions: administration and supply, tactics, air corps, militia bureau and the Adjutant General. Direction of the Army would be lodged in the body composed of the heads of these divisions. The first concern of friends of industrial preparedness, of course, is the disposition to be made in any contemplated reorganization of the principles in which we are primarily interested. Naturally in such an organization as that proposed, the functions of the Ordnance Department would come under the commissary general of supply. The plan in this respect provides that "all so-called supply agencies of the Army (as defined by the Services of Supply in France) should be combined under one head—a *military* head, who should take over the function of the Supply Section of the General Staff and *the supervisory functions of the Assistant Secretary of War (Industrial College, etc.)*" (italics ours). Similarly under the same head would be placed the Quartermaster General who would lose construction and transportation functions; the director general of transportation—a new service; the Chief of Engineers who would absorb the Signal Corps, take over construction functions from the Quartermaster General and lose all combat functions; the Surgeon General and the Chief of Finance. In addition to abolishing the Signal Corps as such the Chemical Warfare Service would be absorbed by the Ordnance Department. On such a regrouping there need be no serious difference of opinion.

Whatever merits or demerits may exist in these and other phases of the plan, we have no hesitancy in saying that a serious mistake will have been made in any reorganization which interferes with the present supervisory supply functions of the Assistant Secretary of War. The memory of military students is indeed short-lived when it proposes any annulment of one of the greatest advancements of the National Defense Act of 1920. We take the liberty of restating the reasons and the experiences of those who were responsible for the industrial preparedness provision of the Act and submit that those reasons are as good today as they were thirteen years ago and they will be as necessary in another major war as they were in the last. Even though some observers are concerned that the supervisory functions of the Assistant Secretary of War have not been allowed to operate as the Act intended, still there is no warrant for changing that part of the War Department organization.

THE Hagood plan is advanced on the theory that—to use his own words—"The War Department has always collapsed at the outbreak of every war and the present organization will collapse at the outbreak of the next war because it is too topheavy, contains too many conflicting agencies—has too much divided responsibility—to handle with promptness and efficiency the unimportant little problems of peace. The shock of war would destroy it." Yet the department's breakdown of 1917 was a breakdown in munitions production and the present organization grew out of the experience gained in remedying that collapse. The shock of war may destroy some parts of the machine; it would not destroy the functions of a civilian Assistant Secretary of War.

To emphasize this point it is necessary only to recall what was in the minds of those who are responsible for the present organization—an organization born of the greatest of all war experience. The desirability of separating the supply activities of the Army from its strictly military activities and placing each under a separate head was first advanced by the then Assistant Secretary of War before the sub-committee of the Senate Committee on Military Affairs in the first session of the 68th Congress. The following testimony before the Committee at that time is in point. Senator Wadsworth of New York was Chairman of the Sub-Committee; the Hon. Benedict Crowell, wartime Director of Munitions and Assistant Secretary of War, was testifying:

The Chairman: "In a sense your suggestion would bring about the creation of an office of equal importance with that of the Chief of Staff as now created?"

Mr. Crowell: "Yes, sir."

Senator New: "You take away from the General Staff the

business operations and put them under the office of the director of munitions?"

Mr. Crowell: "Yes. . . . All the functions of the War Department can be divided into two main groups, the military function and the munitions and supply function. At the head of the War Department stands the Secretary of War, and he should naturally have two chief advisors. The head of the military establishment should advise the Secretary of War on all military matters and the head of the munitions department should advise the Secretary of War on all matters relating to munitions and the supply of the Army.

"All orders of the Secretary of War relating to military matters should be handed down from the Secretary of War, through the head of the military establishment, to the proper departments. All orders of the Secretary of War relating to munitions should be handed down, through the Chief of Munitions, to the proper departments. The head of the military establishment would, therefore, have charge of all military matters, such as the training of troops, the operation of troops, etc. He should have no authority whatever over industrial matters. The Chief of Munitions, on the other hand, should, with his staff, have charge of all matters relating to the munitioning of the Army, but should have no voice in military matters. . . .

"Directly under the Assistant Secretary, whose title for shortness we will consider to be Director of Munitions, would be a small group of men designed to coördinate the supply functions of the bureaus. . . .

"The bureaus I deem necessary for the proper execution of the munitions program of the Army are the Ordnance Department, Medical Department, Transportation Corps (which should include Motor Transport), Construction Corps (which should include the real estate department), and the Chemical Warfare Service, and there should also be under the control of the Director of Munitions the finance department. These various corps and bureaus should be charged with the duties the war has developed for them to perform, and, while it should be the privilege of the Secretary of War to choose the head of each bureau from the Army at large, those bureaus charged with specially technical service, such as the Medical Department, Engineers, Ordnance, Signal Corps, Chemical Warfare, and Construction, should have personnel specially commissioned. . . ."

WHEN the bill which ultimately became the National Defense Act of 1920 was before the Senate for adoption, the statement of Senator Wadsworth was historic and sounded the keynote of industrial preparedness for all time. He said:

"This bill attempts, for the first time in the history of military legislation, to inject into the War Department the civilian business mind, and to do it by statutes, and yet to do it in such a way as not to make it too rigid, not to make it too binding upon the Secretary of War or the Army itself; in a word, to do it in such a way that the typical business and industrial mind can come into intimate contact with this problem of production in the War Department.

"So we establish the office of Undersecretary of War, and we charge him with the general supervision of all the procurement and production activities of the Army. He will have general supervision of the Ordnance Department in its procurement and production activities, the same for the Quartermaster Department, the same for the Signal Corps, the same for the Engineers, and all those branches of the service whose duty it is to go out and buy goods and make the contracts.

"The Undersecretary of War, in a sense, is given equal prestige with the Chief of Staff. As a matter of fact, we make him the immediate successor of the Secretary of War himself in the event of the absence of the Secretary from his duties. He is to meet with the Secretary of War as presiding officer, the Chief of Staff, and the General of the Army, in what is known as the war council. That war council will be presided over by the Secretary of War. On one side of the table will sit the strictly military chief of the Army, the Chief of Staff, and on the other side of the table will sit the industrial and business chief of the Army in the person of the Undersecretary of War. . . ."

IT will be seen that in the mature judgment of those who carried the burdens of the supply functions of the War Department in the World War, this division of military and industrial activities is a prerequisite to success in another emergency. He who would return to the old system in the face of that experience would tamper with one of the most important applied lessons of the World War. Hence when General Hagood recommends that a military aid replace a civilian in this block of the organization chart he is undoing the good results which were purchased at so high a cost fifteen years ago. Others may with good reason share his inference that the scheme has not always worked in its thirteen years of trial. Too often the civilian mind has allowed the professional advisor to usurp the functions organically provided by law. Even so, as serious as that condition may be, the present organization has war-time conditions in mind. The one and only purpose of all national defense on land, on sea and in the air is the best working combination which will produce victory in combat. We learned only too well that the industrial problems of munitions supply are the day-in and day-out problems of industry multiplied a million fold. In peace time they require the businessman's viewpoint and as they become increasingly complicated, as they do in war, they will require that viewpoint and experience all the more. War of tomorrow will emphasize in greater degree than did the World War that success on the battlefield is not a question of manpower alone. It is in growing degree a matter of coördinated industry and supply. As alert, as competent and as well trained as any commissary general of supply might be, modern war will always require a well-trained, two-fisted, hard-headed industrial executive, a business man, at the head of production to guarantee that munitions are produced when and where needed.

If we are to fight the next major war on any other theory then we will have disregarded a great lesson of the World War. If we should so attempt to fight the new war, then on M day it would be well to have an efficiency expert begin his studies to reorganize the industrial mobilization of the department three months later under a civilian Director of Munitions. On this score General Hagood is flaunting costly experience. With his great ability he may be able to train a soldier in ten days for all we know. The silver-tongued Bryan once said something about a million men springing to arms overnight! Willy nilly, that is the job of a soldier. By the same token, coördinated production of supplies in manufacturing plants of the nation at war is the job of a civilian industrialist. Both are essential to victory—it will be as hopelessly impossible to get along without the one as it will without the other. That is an axiom because it is a proposition the truth of which is so evident no reasoning or demonstration can make it plainer to any student of peace.

Communications

The Ancient Cycle of War

THE EDITOR:

The article "The Ancient Cycle of War" in the March-April issue I read, attracted by the title. In the words attributed by your author to St. Jerome (page 280) I was "at a loss for words." I studied over your notations on the author (page 275), and I read the article again, and checked through it several times. I regain my loss of words, but I remain astounded that an author of Capt. Nickerson's apparent reading and writing ability should so far pillage and sack history and draw such conclusions.

As to military facts, and those things that had to do with the civil wars, Captain Nickerson is conscious of the passage of time in his narrative, but not of the change in the constitution of peoples. From the glorious days of free speech and public councils when Thales wrote, down to the days of Alexander, there was a span of 1,300 years. Through those years ran continuous inbreeding of different bloods, especially remembering that the slaves became free after the second generation. Through those years ran cycles of terrible degenerate morals and awful political conditions. At Sparta's height, or "prosperity era," as we would call it now, the organized political racketeering was collosal. Reading closely the real history of the Greek Republics gives the impression that it is impossible for a republic to endure for a long period without degeneration.

I believe that under an unbridled individualistic system that this is so, even such a system as was prevalent in the United States before 1929. In a book which I have just completed I devoted some space to the proof of this. Aristotle pointed out, 450 B. C., that "It is improper that the person to be elected should canvass for the office," so great was the buying of votes and debasement of the common people in Sparta. We went through a period of "campaign contributions" in this country, and the debasement will look very bad in future history, in spite of the fact that we have higher Christian moral ties that were not present in the old pagan world. Greece was not "dragged down by a century of civil wars," but the reverse was true. The almost complete impoverishment of the blood of the upper classes by birth control in the face of a tremendous increase of the ignorant freed slaves and the surreptitious offspring of slave women with Greek fathers, formed the cause and the background of the civil strife.

What happened in Rome? In the first place, the span of years is so long that there was no "typical army." The army of the first republic enlisted men according to their property holdings. A wealthy land holder was sent into the first phalanxes. He was a "spear and shield man," because it was held that the first responsibility for the defense of the state was for those who owned the land. The non-property holder had only a secondary responsibility, and the slave had none. This theory, which, incidentally, would be a good one for the United States, was responsible for the superior fighting of the armies of the early republic. It was an honor to belong to the front-line troops, and the sons of the patricians made up these units.

But luxury and greed of the upper classes ruined the Roman Republics. A few hundred families came to possess all the wealth and lands. "Latifundia" existed on an enormous scale with one family owning whole regions and cities, and no opportunity for the common people to be anything but miserable serfs. Three hundred thousand beggars stalked the streets of the towns of Italy alone at the time of Tiberius Graccus, who was the Henry George of that day. Plautus, at that time, wrote *Homo homini lupus*, "Man is a wolf to man," equivalent to our "Dog eat dog" methods of "individualism" just before 1929. It was the greed and inhumanity that drove the populace to desperation, not the civil strife that made the bad conditions.

The men of the armies that went into Gaul stayed for five or ten years. The common soldier brought no family with him. He lived in the towns with the native women. He hated the aristocracy, and he hated Roman life. By the time the soldier placed Claudius on the imperial throne, a century later, the whole of Gaul was as permeated with Latin blood, and with the blood of Thracian and Dacian freedmen, as New York City is today with Irish, Jewish and Italian. Trajan, who came to the throne in A. D. 98, was a full-blooded Spaniard. At this time Juvenal pointed out that all the lawyers, judges and leaders of Rome were coming from the lower classes, the rabble, while the upper classes had at most one or two petted and spoiled children. He satirized this as "Fate stands tittering by and smiles complacent on the sprawling brood."

Eighty years later this happened with the beginning of the military anarchy. In 192 A. D. the empire was actually put up at auction by the soldiers. The throne was sold for approximately a $300 bonus for each soldier, but the soldiers of the provinces did not get their share, and the British, Syrians, Albanians and Africans each put up an emperor. The lowest point of moral decay in the history of the world is claimed to be about A. D. 200, though such a thing is impossible to set. The records of the time are so atrociously indecent that translators seldom or never tell the whole story.

From the military standpoint, the different sections of the armies after the time of Augustus Caesar spoke different languages and had little pride in the Imperial city. Italy and the City of Rome were certainly more than ninety per cent mixed blood. Of the older provinces practically every family had Latin blood. In the far provinces whole armies were full-blooded foreigners, knowing no Latin. Commodus took 20,000 full-blooded Quadi into his army at one time (A. D. 180).

The idea of Captain Nickerson that an army of 150,000 men defended the empire is the bunk, and has no foundation in any history. By the year 180 there were more than that number of Germans alone in the army. Probus (A. D. 275) had 16,000 young Germans in one army unit, and he had with him 100,000 Bastarnae. In A. D. 330 the legions were so entirely foreign that the emperor reduced the standard from 6000 to 1500 men each, so that their commanders would have less individual power for rebellion. Valens had 200,000 Goths in his army in A. D. 375.

There is no guessing to be done about the size of the legions. Six thousand was the standard of a full legion at one time, but a legion could be anything from a skeleton organization of 400 to an army of 40,000 Germans or Quadi.

We know that the "buff and belt man" after Caesar's time was a rough communistic type who hated the aristocracy for good reasons, and he did not care to dwell long at home in the despicable life of the city slums. He forced a dole as often as he could, and he elected his officers when he could. When he could slip out of the service and live a peaceful life with a Gallic or Thracian wife on the frontier he did so, and he was thus the father of our present European. There can be no "local patriotism" in the riotous greedy oligarchy, only one civil war after another, and that is what Rome got from the time of Cato, who, incidentally was a perfect old-time Al Smith, down to the time when Theodosius wrote to Honorius, the last emperor, the real solution for ending civil wars: "Neither watch nor guard nor yet a hedge of spears can bring thee safety; only thy people's love can do that. And love thou canst not extort; it is the gift of mutual faith and honest good will." That is good advice for leaders even today.

GEORGE S. BRADY,
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Professional Notes

Development of Mechanical Time Fuzes

BECAUSE the following account tells so well the story of the development of any artillery fuze of importance and because the life work of Herr Thiel typifies the devotion and application of many ordnance engineers in the diversified problems of military progress, it is published here as a tribute to a great German technician and to all others who have faced similar ordnance problems. The account is a translation from "Making Time Fuzes" by Major Weidinger published in the January, 1933, issue of *Wehr und Waffen*.

"The death, on the 3rd of June, 1932, in Rhula near Eisenach, of 'Kommerzienrat Heinrich Thiel,' draws attention to an important piece of our artillery matériel; namely, the German mechanical time fuze from whose developments the name Thiel cannot be separated.

"Thiel, born on the 25th of April, 1867, was the son of a manufacturer, Christian Thiel, the founder of the world famous watch factory of Gebrüder Thiel in Rhula. After receiving a thorough technical education, he was taken into the firm in 1895 as a partner, together with Oheimen Reinhold and Ernst Thiel. When the partnership was converted into a stock company in 1901 he became business manager. In 1913 the title Kommerzienrat was conferred upon him by the Prince of Gotha.

"Even before the turn of the century, there had arisen in all states the desire to substitute for the powder train time fuze a time fuze which would be independent of all effects of the atmosphere. Many inventors concerned themselves with this question and many suggestions (in part of a quite fantastic nature) were made, without, however, a real service design being produced. It was not until the year 1903 that a patent was issued to the Berlin watch maker Bäker for a time fuze driven by clock work. During the years 1904 and 1906, Bäker was given further patents. The basic idea of these patents was a clock work driven by a spring and using an escapement with a comparatively high frequency. The Bäker patents became the property of the Krupp firm through purchase. As the workshops of the Krupp firm were not equipped for the manufacture of watch movements, that firm in 1903 entered into an agreement with the firm of Gebrüder Thiel for the production of mechanical time fuzes according to the Bäker patents. Here began the untiring work of Heinrich Thiel, which only came to an end through his death.

"In close coöperation with the Krupp firm, every single piece of the movement had to be developed through numerous firing tests. In spite of many failures, Heinrich Thiel never lost courage. He always succeeded in developing new ways of overcoming the difficulties encountered and in keeping up the interest in mechanical time fuzes.

The first firing tests took place on the 6th of January 1906 at Tangerhütte. These tests were continued with varying success and in close coöperation with the then Artillerie-Prüfungs-Kommission until the end of the year 1903. The original movement as Bäker had designed it, had in these years been basically redesigned. Only the driving spring and the escapement remained and these even in a different form and arrangement.

"In 1909, Heinrich Thiel saw his untiring work rewarded by the adoption, upon the completion of the firing tests, of his fuze by the German War Department, as the combination fuze; i.e. 'doppel Zünder 0.8.'

"When mass production was started in the year 1910, serious

setbacks were encountered. The first deliveries performed without trouble. As the mass production proceeded further, the fuzes on acceptance test gradually gave more and more failures and prematures and at times gave excessively high dispersion. For the firm 'Gebrüder Thiel,' this was a great catastrophe, especially as they had given up a part of their watch business to make room for the production of fuze movements. Heinrich Thiel, who was held responsible for the mechanical time fuze development, was looked upon very unfavorably by the directors and stockholders. Only his strength of will and his unshakable faith in the final success can be thanked for the further development of the fuze against the advice of his stockholders. The movement now had to be entirely redesigned. In September, 1911, a new design was presented to the Krupp firm whose Director, Prof. Rausenberger, considered the further development of a mechanical time fuze of greatest importance, and a program of development of the fuze was agreed upon.

"In March, 1912, the first firing tests of the new fuze took place. Several more years of extensive tests were required before the fuze was made to meet the requirments of the War Department. In 1916, it was again put to service in the German Army. By the end of the World War, the production reached a height of about 6,000 fuzes per day.

"The great services of Kommerzienrat Heinrich Thiel in developing the mechanical time fuze, and thus increasing the effectiveness of weapons, was recognized by the highest military authorities during the course of the World War who conferred upon him the iron cross with the black and white ribbon.

"The close of the War rapidly brought the production to an end. The workmen who were skilled in the art of mechanical time fuze production had to be discharged and the equipment needed for the production was destroyed at the orders of the inter-allied control commission.

"From 1919 to 1924, the production of mechanical time fuzes was at a full standstill. It was not until the end of 1924 that the small production permitted by the Versailles Treaty was again undertaken. Again it became the principal responsibility of Kommerzienrat Heinrich Thiel to put the movement into production. With the help of his faithful coworker, Director Liebergeld, he was successful in further developing the movement to such a point that today it meets all requirements and the competition of any foreign fuze. Until the last days of his life, the principal interest of Heinrich Thiel was the mechanical time fuze which, in spite of the greatest difficulties and opposition, he had at last brought to a successful conclusion. The name of this honorable German man must always remain connected with the history of the development of German ordnance." (*Wehr und Waffen, January, 1933.*)

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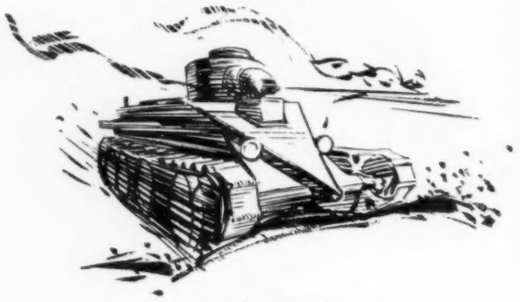

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Book Reviews

Inevitable War. By Lieut. Col. Richard Stockton, 6th. New York : The Perth Company. 1932. $7.50.

THE author of "Peace Insurance," "Troops on Riot Duty" and "The Guardsman's Handbook" in this, his latest volume, presents one of the most complete studies of American military policy ever to come to the attention of this reviewer. Colonel Stockton's previous works had already won for him acknowledgment as a recognized expert on military subjects. An officer of unusual line and staff experience in peace and war, his writings merited for him the recognition of the old Military Service Institution when he was presented its gold medal on three different occasions. His contributions to military publications and his lectures have enhanced his standing as a student of the American Army.

That this study is most complete is evidenced by the fact that the volume contains 806 pages, every one of which is crammed with either historical fact or irrefutable logic. No better purpose could be served by this review than to indicate briefly the method of treatment which Colonel Stockton has adopted. In Book 1 he shows how past efforts for peace have failed regularly throughout many centuries and how modern pacifist claims are merely monotonous repetition of that which history time and again has shown to be wrong.

In Book 2 the thesis is that the causes of the long and consistent failure to secure peace still exist. Interesting indeed is the analysis of this fundamental question. As the basic cause of war Colonel Stockton cites "the inability of the human mind to determine accurately and inevitably that which is right and that which is wrong; that which is fact and that which is not fact; that which is best and that which is not best."

The author shows that there is no indication that any existing projected or probable efforts can remove the basic cause of war either now or for hundreds of years to come and from this he arrives at the conclusion that wars are inevitable and we must be prepared to face them. From this point on the historical treatment of the subject is superb. Thirty successive Presidents of the United States are shown to have been as one in advocating preparation against defeat in war. Historically also a good case is made to show that reasonable armament is never a cause of war—but rather a result of the fact that war is inevitable—and that proper preparedness is not a financial burden to a nation like the United States.

This study leads logically to the conclusion that successful conduct of future major warfare will require more peace-time preparation than ever before in the form of better national organization, better planning, more training and discipline and scientific instruments of warfare. The author, in addition to a well versed knowledge of the military aspects of our past and present, is one of the few who understands the real significance of industrial preparedness.

There is a great deal of human interest throughout this volume such as, for instance, the statement made by "Uncle Joe" Cannon in Congress, April, 1896: "I want to say that I do not believe we will have war the coming year—nor war this year nor next year nor the year after. I doubt if there will be any during this century or perhaps the early years of the next century." Two years later war with Spain was declared! And again when Doctor David Starr Jordan, President of Leland Stanford University, wrote in 1914, "It is apparently not possible for another real war among the nations of Europe to take place.

What shall we say of the Great War of Europe ever threatening, ever impending and which never comes? We shall say that it will never come. Humanly speaking it is impossible." As the author observes, almost before the ink of Doctor Jordan's statement was dry, the greatest war of history broke out in Europe. As usual the pacifist was wrong.

America in the World War. By James G. Harbord, Major-General, U. S. A. Boston: Houghton Mifflin Co. 1933. $2.00.

IN the brief space of less than one hundred pages, General Harbord epitomizes the story of America's military activities in 1917-18. The history of these months is skilfully related to the larger background of the World War and to the operations of the allied forces before and after our entrance into the war. General Harbord is intensely loyal to General Pershing, and writes feelingly of the latter's success in preventing the attempted use of American soldiers as replacements in the French and British armies. The author is extremely modest in recounting his own distinguished service. This excellent little book recalls the spirit of those far-off days, and fairly and accurately describes the achievements of the A. E. F. on the Marne, in the Meuse-Argonne, and in the other engagements. It is an excellent summary of this country's fighting on the western front.

Tattered Banners. By Talcott Powell. New York: Harcourt, Brace and Company.

A SMALL minority of the American people is certain to condemn this book. The other ninety-nine per cent, however, should rejoice that Mr. Powell's ability equals his courage in describing the abuses of our pension system. When a fourth part of the federal revenue is distributed to less than one per cent of the population, the reasons for the existence of these favored few will bear investigation. Political cowardice and vote-seeking combined with the selfish demands of a comparatively few of our war veterans are shown to be responsible for a good portion of our federal deficit. That this condition has been bettered by the unique legislation of recent weeks is no reason to assume that all is well or will stay well. One need only consider the history of the demands of war veterans in ancient Greece and Rome, in Elizabethan England, in our own country since its foundation, to realize that the sudden defeat just suffered will be followed by later increased demands on federal funds.

Mr. Powell's survey of historical precedents is extremely valuable in showing the way of the war veteran in demanding recompense for service rendered. The wounded and the dependents of men killed in battle, men whose disability can be traced to war service, are regarded most sympathetically by the author who of course does not deny the validity of their claims. But the unworthy and undeserving veteran frequently receives more than the wounded man and the needy orphan. Such racketeering must be stopped. Mr. Powell's impassioned and well documented description of the war veterans' racket in this country will arouse the indignation of all honest citizens, and none more than the patriotic veteran who refuses to put a cash price on his war service.

The New International Year Book: A Compendium of the World's Progress for the Year 1932. Edited by Dr. Frank H. Vizetelly. New York: Funk & Wagnalls Company. 1933. $6.25.

THIS is the second issue of the New International Year Book to appear under the imprint of the Funk & Wagnalls Company and first under the editorship of Doctor Vizetelly who carries on the splendid tradition established so painstakingly and thoroughly by the former editor, Maj. Herbert H. Wade, a member of the Army Ordnance Association since its foundation.

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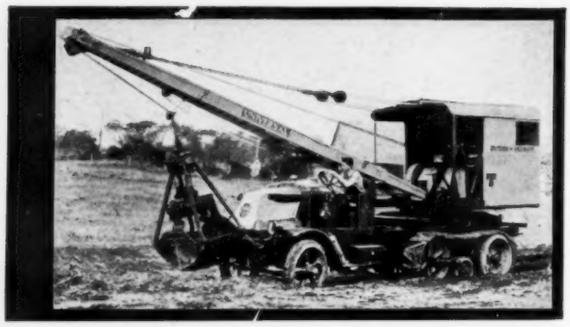

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A few years hence, when we can see the events of 1932 in retrospect, we will doubtless discover that much of the ground work of our rapidly changing civilization was laid in this critical twelve-month period. Nations went off the gold standard; the League of Nations wrestled with the problems presented by the Chinese-Japanese situation; violent political upheavals occurred in many countries. Dwindling world trade became a problem which engaged some of the greatest minds of the day.

This brief mention of but a few of the many important happenings of 1932 that are treated in this latest volume must offer convincing proof of the value of this unique book of reference, if such proof be needed. In addition, ample space has been assigned to a broad range of subjects which includes surgery, literature, theater, science, engineering, history, philosophy, naval progress, painting, sculpture, art exhibitions, law, etc. Most of the contributors to earlier year books are again represented by articles. Brig. Gen. John T. Bradley again contributes an epitome of military progress for the year.

Beauregard, The Great Creole. By Hamilton Basso. New York: Charles Scribner's Sons. 1933. $3.50.

IN 1838 there was graduated from West Point a cadet whose work had so pleased the instructor in artillery that after graduation he was continued on duty as assistant instructor. The cadet was young Beauregard; the instructor was Robert Anderson. In 1861 General Beauregard ordered the attack on Fort Sumter which was commanded by Major Anderson. Major Anderson had had an apt student, for Sumter soon became untenable.

Beauregard was undoubtedly one of the distinguished soldiers of the Confederacy, and yet no account of his life had been written previous to Mr. Basso's sympathetic biography. The frustration that doomed him in life to secondary roles seemed to destine him in death to comparative oblivion. Mr. Basso has done much to restore to Beauregard's memory some of the glory that had made him the hero of the South after the fall of Sumter and the victory at Bull Run. Shortly after that battle he became "a lost soldier in a lost cause," and the reason was the unfortunate feud with Jefferson Davis. Mr. Basso does not hesitate to take sides in this controversy, and to place the entire blame on Davis for failure to use Beauregard's military talents in the service of the Confederacy. In spite of the obvious efforts to relegate Beauregard to inconspicuous duty, he rendered signal service to his country in the later defense of Charleston and in bottling-up Butler's forces on the James. Civil War history has been illuminated by Mr. Basso's study of an extraordinary personality which lacked some of the elements essential to greatness, but which was characterized by many qualities entitling him to posthumous fame.

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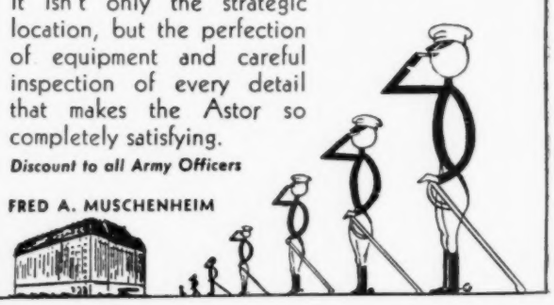
FRED A. MUSCHENHEIM